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ABSTRACT

This study contrasted the science-related cognitive skill attainment of children experiencing high and low individualized science programs. In addition, skill development was compared between open space schools and conventional schools. A total of 903 fifth-grade pupils from seven schools were given a short revision of the Bristol Study Skills Test and a Student Questionnaire. Concurrently, teachers were given two instruments that would report their instructional practices and open classroom beliefs. The analysis of the results indicated that students experiencing high individualized science programs perform significantly better on the first four parts of the Bristol. The multivariate analysis of covariance statistically controlled for the effect of parents' educational level and unique classroom effects. Students in open space schools likewise scored significantly higher on science-related cognitive skills than students attending conventional schools. Analysis of subgroup results (i.e., school, sex, and race) were also reported. Relationships between teachers' open classroom beliefs and their instructional practices were negligible. A similar finding was reported between student cognitive performance and teachers' open classroom beliefs. (Author/MH)

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Relationship Between the Degree of Individualized Instruction and Children's Science Related Cognitive Skill Development in Open Space and Conventional Schools

Marvin D. Patterson
Nova University

SE 020 889

Relationship Between the Degree of Individualized Instruction and Children's Science Related Cognitive Skill Development in Open Space and Conventional Schools

by

Marvin D. Patterson

DISSERTATION

Submitted in partial satisfaction of the requirements

for the degree of

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in

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in the

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of

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Approved:..

Abraham S. Fischler

Marilyn Segal

Earl Hughes

....

Committee in Charge

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Chapter One

The Problem

Introduction and Statement of the Problem

For a number of years experienced educators have been espousing the need to develop approaches to instruction that would better accommodate individual differences. Individualized instruction has been proclaimed by many, especially in the past ten years, as a desirable instructional model to adopt (see ASCD, 1962). Through such an approach, educators believe that the human potential of students has a better chance of being actualized than through traditional approaches.

A number of national projects to individualize instruction have been attempted, such as Individually Prescribed Instruction (IPI) and Program of Learning in Accordance with Needs (PLAN). Major corporations have expended millions of dollars in developing individualized instruction software. Furthermore, school districts are investing large sums of money to develop or purchase individualized materials. Evidence that the movement is continuing is provided by federal investments in developing individualized curriculum materials. Recently, the National Science Foundation provided funds for launching a new high school science curriculum development project, Individualized Science Instructional System (ISIS). Although some studies have been completed that report the cognitive results of such programs, little is known about the relationship between the degree of individualization and student achievement.

While attempts to individualize instruction proceed, new cries for radical school reform are being made by critics such as Holt (1969), Kohl (1969), Kozol (1972) and Dennison (1969). These critics have charged that the control that schools maintain over children drains children of the essence of childhood itself. The research findings of Silberman (1970) suggest that alternative forms of education that are more informal, open and free are needed. The open classroom movement and the Free School movement in the U.S. are examples of alternatives that are currently being tried by educators who refuse to continue schooling by traditional instructional practices. Advocates of the open classroom philosophy claim that explorations with concrete materials in a classroom structured and created by the teacher positively influence the cognitive and affective development of the child.

As a new approach to school construction, open space schools are being used by school districts as a means for encouraging changes in instructional techniques. A primary reason for creating open space school designs is to experiment with various innovative techniques such as individualized instruction. Advocates of open space schools claim that when these techniques are combined with the open classroom approach, significant differences in the level of cognitive attainment should emerge between individualized open space programs and programs housed in conventionally constructed schools.

In science education today there is a need to determine what effect the degree of individualized instruction has on the cognitive skill attainment of children. The thesis tested in the present study was that in open space situations where teachers with an open classroom philosophy appear to be individualizing instruction, chances seem to be good for producing children who are superior in science related cognitive skills. Thus, the study was designed to establish the relationship between these four factors: type of school constructio[illegible].e. open space or conventional), degree of individualization, extent of open classroom philosophy and the extent of science related cognitive skills attained.

The present study was conducted to explore these basic questions:

1) When classrooms are classified as high or low individualized, are there major differences in the science related cognitive skills of children?
2) How does student cognitive performance differ in open space and conventionally constructed schools when both are providing highly individualized programs?
3) What science related cognitive differences exist between racial groups in open space and conventionally constructed schools?
4) How does the degree of individualization as reported by teachers relate to their ideas about the open classroom?

Definitions

For purposes of this study the following definitions will apply:

Individualized instruction. A student centered approach to learning wherein individual student differences are taken into account when designing each student's program of study. The ideal approach to individualized instruction provides alternatives to students in these five areas: 1) the variety of content available; 2) the amount of content required; 3) the rates of learning expected; 4) the sequence of the content provided; and 5) the variety of methods or activities used.

Open classroom. A classroom may be described as an open classroom when the following criteria as set forth by Hollingshead (1971) have been met:

> "1) the room itself is decentralized: an open, flexible space divided into functional areas, rather than one fixed

> homogeneous unit; 2) the children are free[1] for much of the time to explore this room, individually or in groups, and to choose their own activities; 3) the environment is rich in learning resources, including plenty of concrete materials, as well as books and other media; 4) the teacher and her aides work most of the time with individual children or two or three, hardly ever presenting the same materials to the class as a whole. (p.ii)."

Open space schools. Often referred to as open plan schools or open schools; the open space schools provide a flexibly constructed facility often without any interior walls. The setting is designed to encourage individualized instruction, cooperative teaching, and non-gradedness, while at the same time tending to discourage traditional teaching. Often the area is divided into primary and intermediate areas and separated by a library area or media center.

Conventional Schools. Refers to schools that do not include open space construction in their design. Classrooms are separated from one another, typically by four walls and frequently connected by hallways. Conventional schools, although physically different than open space schools, may still provide individualized instruction and open classroom organization. It is the architecture of these schools that make them conventional and not their programs.

Science related cognitive skills. Includes those science related intellectual abilities that help the child understand and inquire into his physical envrionment. Examples of these skills include the following: 1) the ability to make inferences about the physical properties of objects, their structure and interactions in different situations; 2) the ability of children to produce explanations about their experiences with materials in classificatory or conservatory situations; and 3) the ability to make interpretations of graphic and pictorial materials.

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[1] Many advocates of good informal classrooms would question Hollingshead's use of the phrase "the children are free..." The structure created by the teacher and her expectations for cooperative behavior will limit the child's freedom.

Significance of the Study

The literature, as will be shown in Chapter Two, is void of empirical studies about the effects of varying degrees of individualized instruction. A clear need exists to develop a means to quantify this factor. Science at the elementary level typically is not recognized as a major instructional priority, but rather must follow skills instruction in reading and mathematics. However, many of the science related cognitive skills that children develop through direct experience are more applicable to understanding phenomena in the real world of the child.

The major thrust of the present study was to contribute to a better understanding of the relationship between the degree of individualization practiced in classrooms and children's attained science related cognitive skills. Supplementary questions were included to contrast the science cognitive performance of different racial groups in different types of school facilities (i.e. open space and conventionally constructed schools). The instrumentation and information derived from the study should be useful to educators who are curious about how individualized practices relate to children's cognitive abilities.

Chapter Two

Review of the Literature and Statement of Research Questions

Scientific Inquiry and Science Related Cognitive Skills

Educators who have the responsibility of designing a comprehensive curriculum in science are faced with a number of important decisions. These decisions revolve around major questions such as: 1) what is to be the content of the instruction? 2) what is to be the mode(s) of instruction? and 3) what is to be the means of evaluation? In order to decide what curriculum strategies to apply to such questions, the science educator must first gain a perspective of the structure of science itself. Foshay (1961) asserts that each discipline is characterized by its domain--or conceptual scheme of structure--and its way of knowing or method of inquiry. Schwab (1962) relates the structure of science to inquiry in that he defines the structure as those concepts which constitute the domain of the discipline and determine its inquiry.

If one accepts this view that science not only consists of content but also methods of inquiry, then both of these elements need to be included in a science curriculum if the design is to be valid. That inquiry skill development should be included in the basic design of the science curriculum, is attested to by many in the literature (Brandwein, 1968; Butts, 1964; Fischler, 1965; Gagné, 1963; Hurd and Gallagher, 1968; and Suchman, 1962). In 1963 Gagné suggested that "inquiry is perhaps the most critical kind of activity that the scientist engages in, and for that reason must represent one of the most essential objectives of science instruction (p. 144)."

Since inquiry is such an important learning activity, a clear definition of the term is needed. Novak (1964) defines inquiry generally as the total configuration of behaviors involved in the struggle of human beings for reasonable explanations of general phenomena about which they are curious. More specifically, one might view inquiry as those activities that scientists do. Gagné (1963) suggests that inquiry is a set of activities characterized by a problem-solving approach, in which each newly encountered phenomenon becomes a challenge for thinking. Even more important to the present study is the view held by Hurd and Gallagher (1968). They classify inquiry skills as a category of cognitive abilities or skills in actively seeking new information through experimentation and in developing models to explain data. Inquiry is viewed by these science educators as those knowledge-acquiring skills, called cognitive skills or process skills, that are similar to the procedures used by scientists to acquire new knowledge. Thus, for purposes of this study, inquiry skills will be viewed as those science related cognitive skills important in the intellectual development of children.

Hurd and Gallagher (1968) continue to list four categories of process skills or cognitive skills that are essential for the understanding of science information. These are: 1) obtaining information already perceptually available--what is at hand and needs only be noticed or observed; 2) the ability to measure and to use numbers to represent measurements, thus helping the student to think about objects in a numerical sense, such as weight and volume; 3)going beyond the data or information to detect trends, make inferences and predictions; and 4) actively seeking new information through experimentation and in developing models to explain data.

Conditions for Inquiry

Gagné (1963) in his discussion on the learning requirements for inquiry suggests that the student should be provided with opportunities to carry out inductive thinking; to make hypotheses and to test them, in a great variety of situations: in the laboratory, in the classroom, and by his own individual efforts. But he cautions the reader that for older students to engage in genuine inquiry, they must not only have prior experiences in observing, measuring, classifying, inferring, etc., but must also have acquired substantial knowledge. According to Gagné, then, prerequisite learning of substantive knowledge is essential before the student can assume the responsibilities of a scientific investigator.

Suchman (1964) specifies three conditions for facilitating inquiry in elementary classrooms. First, he proposes that children require a focus for their attention, such as a stimulating problem to pursue. Second, they need physical freedom to reach out for desired data and information and to acquire it *at any rate in any sequence the child wishes*. The third condition to facilitate inquiry is the availability of a *responsive environment* so that when the child reaches out he procures something. By providing such conditions for inquiry, Suchman claims that student autonomy in their operations is fostered. They make decisions and try to satisfy their own cognitive needs by gathering the kinds of information they want.

The kind of responsive environment that Suchman alluded to nearly ten years ago is similar to the settings currently being implemented by open classroom advocates. The next section will summarize how the open classroom approach seeks to provide children with a responsive environment that will enhance cognitive skill development including those science related cognitive skills (inquiry skills) just described.

The Open Classroom

The open classroom movement in the United States can be traced to the instructional practices of the British Infant Schools. After the appearance of Featherstone's writings (1967) about the infant schools of England and the visitations by several educators such as Rogers and Weber, many American teachers began to flock to England to study what these schools were doing. Upon their return to America these teachers began experimenting with similar approaches in their classrooms. The open classrooms that have since evolved in the U.S. have been described by Patterson (1972) as being

> an individualized, child-centered approach to education in which the emphasis is placed upon the child learning rather than the teachers teaching..the classroom is like a functional workshop wherein work or play takes place in various resource centers. These centers are learning areas 'structured' or designed by the teacher either within the room or outside the room in corridors or in the school yard. Teachers are facilitators of learning and the emphasis is on process rather than product, on learning how to learn and maintaining the desire to learn (pp. 5-6).

Earlier in this paper a definition for the open classroom was provided. Rathbone (1971) proposes that in the open classroom the learner becomes an active agent and by his own volition causes things to happen in the environment. Questioning and self-initiated interaction by way of direct experience are the desired student behaviors. Barth (1971) contends that knowledge is idiosyncratically formed; the purpose of school is to encourage exploration, facilitate children's learning to learn...to experiment...to become responsible agents. If the psycho-emotional climate of the school is one of trust and openness, the child will have more acceptance of self and have less fear of failure. It is the child's responsibility to decide what he does and who he becomes.

Weber (1971) states that

> the active force of such learning is considered to be curiosity, interest and the needs of a child's own search for definition and relevance. The school setting or environment must be rich enough to foster and maintain this curiosity; it must be free enough to allow even to help each individual follow the path indicated by his curiosity (p. 11).

This whole notion of exploring the environment to satisfy curiosity is at the heart of the open classroom theoretical position. All the processes that are involved in inquiry can be experienced by the child in open classrooms. Inquiry processes such as formulation of questions, experimenting, observing and inferring are everyday events in the better open classrooms. It might be said that the spirit of scientific exploration is central to the learning process in the open classroom.

Intuitively then, the premises behind the open classroom are attractive to the science educator who believes that science related cognitive skills ought to be developed in children. But what empirical evidence can practitioners offer to demonstrate that the open classroom works?

Achievement data demonstrating the effectiveness of open classrooms are generally not available; few findings have been reported in the literature to date. Many practitioners have proclaimed a moratorium on group testing; others claim their objectives and methods are not reflected in current standardized achievement tests. Still others feel it is too early in the development of open education to submit their approach to a rigorous testing procedure. Since the results from studies about cognitive growth in the open classroom are so inconclusive, further research is required.

Open Space Schools

As previously indicated, in the last five years public schools have been concentrating more on individualizing instruction and furnishing environments that facilitate continuous progress. With the increased experience with these nongraded approaches and with staffs gaining experience with team or cooperative teaching, flexibility in the learning environment became mandatory. The learning space had to be flexible enough to meet the special requirements of independent study, small group discussions, multimedia experiences and large group activities. It became imperative that school facilities be more responsive to the changing needs of the learner and their teachers.

Open space schools, as envisioned by their designers, could theoretically implement the major ideas of the open classroom philosophy given earlier. By providing students with freedom to be involved in making curriculum decisions and the freedom to explore and move about in the environment, open space schools are designed to demonstrate their child-centered approach to learning. The emphasis would be on children learning in independent ways and enjoying the process, not on teachers teaching. The entire setting would be designed to facilitate individualized, continuous progress eduction. The degree to which individualization is occuring in a given open space school is, in theory, one measure of the degree that open classroom theory is being practiced.

The construction of open space schools is a relatively recent development. Brunetti (1971) claims that California set the early pace, but that now the majority of new schools around the country have an open space design. Of over 2,500 new schools constructed during the period

1967-1969, over 50% had open-type designs. Of the new schools constructed during this period only 16% were conventional in California; conversely, only 19% were open in New York state.

Even though many open space schools are not in fact individualizing instruction, the following description is an example of how some open space schools do operate individualized programs. Instruction in such open space environments is fluid and dynamic; that is, teachers and students constantly move about in the open space as activities change. Students often use tote trays to store or transport their materials to different areas rather than being assigned a fixed desk for their things. Traditional subjects are usually studied as in conventional schools except that the mode of instruction is probably different. Learning Activity Packages (LAPs) or other individualized materials may be utilized as guides to study learning (See Wolfe and Smith, 1968). These independent learning guides usually provide the students with objectives to be learned, materials to be used and activities to do. Parent volunteers or older students are often in the environment as aides to teachers.

Since the emphasis in many open space schools is on individualizing instruction, student evaluation is often done in non-traditional ways. Children need not be compared with one another; letter grades may be discarded for different reporting systems. Often children keep their own progress records as they do in many British Infant Schools. Some educators suggest that by keeping his own progress records, the child gains experience important to self-reliance and responsibility.

Results from research into achievement of children in open space schools when contrasted to achievement in traditional schools are incongruous. Only one study was located in the literature that had relevance to the present study. In that particular study involving intermediate level students, Townsend (1971) found significant differences on achievement that favored the traditional schools. This study identified significant differences among sixth graders in word meaning, paragraph meaning, spelling, arithmetic computation, social studies and science.

Individualized Instruction

The movement in education to individualize the instructional program for students grew largely out of the sixties. Programs such as Individually Prescribed Instruction (IPI) and Program of Learning in Accordance with Needs (PLAN) gave impetus to the movement (See Flanagan, 1967; and Bolvin and Lindvall, 1965).

Much of the rationale for individualized instruction was provided prior to 1965 by Bloom (1964) and Goodlad and Anderson (1963). Bloom, in his book, Stability and Change in Human Characteristics, explores the dimensions of individuality and their related factors. He suggests that since variability in intellectual development can be affected by environmental conditions, researchers need to pinpoint the extent to which these positively or negatively influence school achievement. By treating students as unique individuals, many educators believe that individualized instruction is the most viable teaching strategy that schools can employ.

The arguments for the nongraded school provided by Goodlad and Anderson (1963) also apply to individualized instruction. For instance, in the nongraded approach, children who work slowly are provided with longer blocks of time to complete their work; no repeating of grades is necessary since basic differences in learning rate are recognized.

The theoretical rationale for one approach to individualized instruction, Project PLAN, is perhaps best summarized by Mager (1967) in a document describing the experimental version. He states:

> Individualized instruction is the name given to an instructional system designed always to select that procedure likely to be most effective in eliminating the gap between current and desired student performance; that is, most effective in eliminating an instructional need. It is a system of allowing, and assisting the student to reach the constellation of instructional objectives...Rather than merely provide instruction relevant to achieving an objective, individualized instruction provides instruction that is both objective-relevant and student-relevant; rather than be satisfied with instruction containing the appropriate content for achieving an objective, individualized instruction also selects those instructional events and procedures most suited to achievement of the objectives by each individual student (p. 14).

Still, Dunn (1970, p. 221) claims that education doesn't seem to have moved very far in this direction. He cites the number of documents classified by the ERIC Documentation System as evidence. He states that of 1,900 references dealing with curriculum only thirty-six have anything whatsoever to do with individualized curricula, individualized program of study, individualized education, or the like. Of these thirty-six, approximately one-half deal with some form of programmed instruction.[1]

Research into the impact of individualized instruction programs on student achievement has been limited. Wright (1969) in conducting a preliminary assessment of the experimental version of Project PLAN found that during the year, the growth for Grade 5 PLAN students was equal to or greater than that for the controls for all Stanford Achievement Tests (SAT) except Arithmetic Computation. The largest difference, however, was only three months for science. SAT results in the Fall for Grade 6 showed that the PLAN group was three to four months ahead on Spelling, Language, Arithmetic Concepts, Arithmetic Applications, Social Studies, and Science, while controls were about four months ahead on Arithmetic Computation.

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[1] Even though some educators might argue that programmed instruction is individualized instruction, this author contends that it falls short of the definition as presented in this dissertation. Self-correcting materials are often only used to vary the rate of learning while ignoring the other four criteria set forth in this study.

Burst (1972), in a study in which students were randomly selected and assigned to Project PLAN instruction, found no significant differences between PLAN and non-PLAN students on the following achievement measures: Word Meaning, Paragraph Meaning, Spelling, Language, Arithmetic Concepts, and Arithmetic Applications. Non-PLAN students scored significantly higher on Arithmetic Computation.

Research into pupil achievement from the IPI program has produced mixed results. A number of studies have produced no significant differences (See Bialek and Castro, 1968; Fisher, 1967; Gallagher, 1968; and Research for Better Schools, 1968). There were, however, certain affective outcomes that appear beneficial. The firm, Research for Better Schools (1969), report the following benefits: 1) low ability students find IPI most attractive; 2) IPI pupils prefer working by themselves more than control students; 3) IPI math is more enjoyable for pupils; and 4) gifted IPI students demonstrate more independent positive actions than gifted non-IPI students.

James (1969), in studying achievement outcomes of the Intermediate Science Curriculum Study (ISCS) students in individualized settings, found ISCS students consistently surpassed those for a group-instruction class although the results were not significantly different. O'Toole (1966) contrasted the effects of individualized instruction with teacher-centered instruction. No significant differences were found between the groups on science achievement, problem solving abilities, science interests or self-concept.

From the above research findings it is evident that a need exists to clarify the relationships between individualized instruction and development of science abilities. No studies were located in which the degree of individualization was measured and related to cognitive outcomes. It seems that programs are labeled as 'individualized' with no attempt to quantify the degree to which the program approaches an ideal defined by specific criteria. This oversight of educators to describe the independent variable adequately creates problems in attributing criterion differences to treatment conditions. When the conditions are ill-defined, it is impossible to make inferences about relationships between these conditions and performance differences. In school systems where many teachers claim to be individualizing, better psychometric techniques need to be developed to classify teachers on an individualized instruction continuum. One approach suggested by the present study is to utilize a teacher self-reporting measure. If such an approach were successful, then system-wide assessments describing instructional practices would be feasible. Such an inventory effort would greatly help school systems describe what their schools are actually doing to individualize instruction.

The search of the literature also indicates a need to define better the relationship between growth in science related cognitive skills and the degree of individualized explorations with concrete materials. Do schools that provide individualized science experiences actually produce students who are superior in science related cognitive skills? Are there any relationships between teachers' ideas about the open classroom and the cognitive skills attained by their children? Do open space programs yield higher levels of science related cognitive skills in children? A need exists for basic research into the interrelationships of these variables. Such research might prove useful to not only science educators but to others in the educational community as well.

Statement of the Research Questions

(1) Are there significant differences in the levels of science cognitive attainment of children from 'high individualized' science classes in contrast to children from 'low individualized' science classes?

(2) Are there significant differences in the science related cognitive skill attainment of children experiencing only 'high individualized' programs in open space schools vs. children experiencing only 'high individualized' programs in in conventional schools?

(3) What is the correlations between the degree of individualized instruction and teachers' open classroom philosophy?

(4) What relationships exist between teachers' open classroom philosophy and their respective class distributions of cognitive scores?

(5) Are there significant differences in the cognitive attainment of children within various subgroups experiencing either open space or conventional school instruction?

Chapter Three

Procedures and Design

Overall Design

The design for this study was divided into two phases: first, instrument development and field testing, and second, application of the instruments in an investigation of the research questions. The first phase consisted of developing two teacher instruments and testing them on several hundred teachers. The second phase consisted of applying the instruments to a group of elementary teachers of science. This latter phase included testing students of these elementary teachers as a method of measuring students' science related cognitive skills. The design called for statistically controlling such nuisance variables as teacher effect and students' parent educational level.

The research plan consisted of the following steps:

1. field test the teacher instruments on a large population of teachers;
2. give the teacher instruments to a sample of science teachers from a variety of schools;
3. administer the student instruments;
4. analyze the data.

The Sample

Three samples are of concern in the present study. The first is a sample of teachers employed by the Broward County, Florida, Public Schools. This sample was utilized to field test the Instructional Practices Questionnaire, a self-reporting instrument to measure the degree of individualized instruction being practiced. The second sample consisted of seventeen fifth grade teachers of science from the Broward

County Schools. This sample together with the students they were teaching constituted the target groups for exploring the research questions in this study. These seventeen teachers were given two instruments, the Instructional Practices Questionnaire and the Ideas About Teaching and Learning. The students taught by the seventeen teachers were given a science cognitive instrument and a brief questionnaire to be described in the following section.

The Instruments

Teacher Instruments.

1. Instructional Practice Questionnaire (IPQ) - measures the degree of individualized instruction taking place in a given subject area. The instrument was developed by the investigator and the Broward County Research Department (See Appendix A for an example).
2. Ideas About Teaching and Learning (IATL) - measures teachers' philosophy or beliefs about the open classroom and the practices that ought to occur there. The instrument explores teacher opinions about the goals of schools, the role of the teacher, role of the student, the conditions for learning, interpersonal relations, operation of the schools and evaluation methods. This instrument was developed by the investigator and used in a 1972 open classroom assessment in a northeastern city (See Appendix B for an example).

Student Instruments.

1. Bristol Study Skills (The Bristol)- An abbreviated version of the commercial version of this test was utilized in this study. The original test is part of a battery of achievement tests developed in England by Thomas Nelson and Sons, Ltd. Buros' Seventh Mental

Measurements Yearbook (1972) describes Bristol Tests in the following manner:

> The tests represent general skills, strategies, and concepts rather than the content of a particular curriculum...The study skills tests are the most novel aspect of the battery. They assess cultural and scientific knowledge of the environment... Study skills is rather curiously named, since study skills in the sense of use of references, dictionary, indexing, etc. are not assessed...There appears to be a very strong influence of Piaget on much of the content...(p. 4-10).

The following subtest scores are included in the scoring: Properties: emphasis here is on inferences about materials and situations; Structures: emphasis is on Piaget's conservation of substance, weight, etc.; Processes: emphasis is on interpolating mechanical situations; Explanations: the actual content is concerned with Piagetian conservation, classification and scientific reasoning; and Interpretations: deals with knowledge of graphic and pictorial symbols (See Appendix C for an example).

2. Student Questionnaire (SQ) - this questionnaire is an instrument designed to validate teacher responses in the IPQ. Questions were written in student language to explore their perceptions as to the general mode of instruction in science. For instance, it was desirable to know how much student involvement was elicited by teachers when assignments were made. Likewise, the frequency that students worked independently or in groups in science would be useful information in checking the value of the IPQ data (See Appendix D for an example).
3. Parents' Educational Level (PEL) - this information was provided by the schools to the Research Department as part of their

regular data collection. Schools were asked to record for each student the highest grade level completed by either parent as reported on student registration forms. The information, when not available in the regular registration forms, was gathered by the schools by communicating with specific homes. Upon receiving the data forms from the schools, a coding scheme was created by the Research Office staff and applied to the grade levels reported. (For a description of the coding scheme see Appendix E.)

Historical Development of the Study

A. Development of the Instructional Practices Questionnaire (IPQ). During the summer of 1972 exploratory conferences were held between the investigator and the staff of the Broward County Research Department. A major concern of the department at that time was documenting the instructional practices occurring in the schools. A concern in the county was the lack of adequate and quantifiable information that would be useful in understanding the actual instructional practices being utilized in all types of schools, including both open space schools and conventionally constructed schools. A teacher questionnaire describing instructional practices seemed to be a logical way to systematically collect this kind of information.

The present investigator and the Research Staff then jointly began to develop a self-reporting measure for teachers. It was decided to concentrate on developing questionnaire items that would differentiate teachers according to the kinds of individualized instruction practices they were applying in their classrooms. Items were purposefully written in such a manner as to adequately cover the dimensions of individualized instruction previously stated in this study, i.e., items were written to measure: 1) the variety of content available; 2) the amount of content required: 3) the rates of learning expected; 4) the sequence of the content provided; and 5) the variety of methods or activities used.

After preliminary drafts of the questionnaire were completed, a variety of curriculum personnel from the instructional services division of the county reviewed the items. Reading, mathematics and science supervisors provided important feedback prior to finalizing the instrument. It was through this process of involving a number of county personnel to criticize and improve the instrument that content validity was established. Data were later used to establish more objective validation of the instrument and are subsequently reported in this study.

Other forms of validation by classroom observation techniques were seriously considered and the feasibility of such approaches explored with the Research Staff. Due to the shortage of personnel and the ambiguity associated with the drastic and unforeseen staff reorganization in the county that essentially led to the dissolution of the Research Department, plans for formal classroom observations were dropped.

Three separate forms of the Instructional Practices Questionnaire were ultimately produced. One form was developed in each of the subject areas of reading, mathematics and science; the first twenty-four items of each form were identical. Examples of each questionnaire as used in the present study are located and explained in Appendix F.

B. Development of other instruments.

1. Ideas About Teaching and Learning (IATL) - this instrument was designed by the investigator and used in an open classroom assessment

study in a northeastern city. The instrument measures teachers' philosophy or beliefs about open classroom ideals and the practices that ought to occur there. A large pool of items were initially drafted and given to a group of judges to establish content validity. These judges included the directors at the University School on the campus of Nova University and two professors engaged in administrative activities at the school. The instrument was then field tested with the University School staff in the Spring of 1972. After some minor changes in phraseology, the instrument was then given to 220 Follow Through Teachers in June 1972.

2. Bristol Study Skills (The Bristol) - originally this instrument was developed on a diverse population of 1188 students in England. Forms A and B of the commercial version of the Level One Bristol were developed and normed on a sample spanning ages eight years to nine years and eleven months.

A number of changes were made on the original Level One, Form B Bristol Study Skills test to conform to expressed concerns of various county staff. An additional problem existed in that the recommended testing time of 50 minutes would not be available to the investigator. Besides the simple deletion of ambiguous items, five items were dropped due to their dependency on knowledge of the English culture. Other problems of ambiguity in instructions or content were solved mostly by substituting items from Form A. Two items were altered by the investigator, i.e., for Item 32 an additional balance scale was drawn to clarify the question, and for Item 37, the word, clay, was substituted for plasticine.

Since a shorter version of the Bristol had been developed, new estimates of reliability were calculated using the Spearman-Brown formula.

The reliability figures released by the publisher refer to correlations between Form A and Form B. Reliability coefficients are published for each of the five parts of the Bristol. New estimates of reliability for each part were calculated using original figures. The original reliability coefficients and the new calculated reliability coefficients for each part is provided in Table 3.1.

Table 3.1

Estimates of reliability coefficients calculated

for Bristol parts and total scores

Bristol Part	Original	Reduced Version
Part I	.87	.84
Part II	.80	.76
Part III	.79	.64
Part IV	.82	.73
Part V	.86	.79
Overall	.93	.90

The final version of the Bristol consisted of 45 items which equaled two-thirds of the original version. Minor changes in the cover page were also made, thus completing the final form to be utilized in the study. This version was sent to the publisher with a letter of request to reproduce quantities of the test for the present study. Permission to print this version of the Bristol was subsequently received. Appendix G contains the letter of request and the telegram extending permission to reproduce the instrument. This final version of the Bristol is provided in Appendix C.

3. Student Questionnaire (SQ) - this instrument was designed after it became apparent that validation of the IPQ by making classroom observations would be impossible. The Research Office had a history of using student questionnaires as a means of substantiating teacher responses to questionnaires. Even though the correlation, historically, has been only moderate (.3-.5) between teacher and student questionnaires in the county, this procedure was chosen as a means to expedite the validation process and to gain a large quantity of data describing the instructional practices that occur most of the time in each classroom. When classroom observation procedures were under consideration, some brief and informal interviewing of a few students were included and field tested in several schools. The kinds of questions that were asked in such interviews were eventually included in the Student Questionnaire. The result was that all students in the study were able to indicate their impressions about how they study science. The final version of the Student Questionnaire is included in Appendix D.

C. Field testing the Instructional Practices Questionnaire. Following development of the Instructional Practices Questionnaire (IPQ), the instrument was then administered to the entire population of third and fifth grade teachers in Broward County as part of the Research Department's January 1973 Data Collection. At that time all teachers from those two grade levels who were teaching mathematics or reading were asked to complete the IPQ along with other forms for the county.

Only the data from the population of fifth grade teachers were pertinent to the present study. In all, 298 Reading teachers and 270 Mathematics teachers from 60 schools returned the IPQ forms to the Research Office. However, analysis of the teacher responses on the IPQ was delayed until the problem of missing data was solved and reverse scoring of certain IPQ items completed as described in the next section.

D. Preparing the field test data for analysis.

1. Selection of key IPQ items for analysis - A face examination of the IPQ indicates that many items are not directly related to individualized instruction practices. For instance, Items 1 and 22 relate to grouping techniques. These questions do not directly measure the degree of individualization, but rather explore teacher strategies that might facilitate the implementation of an individualized instruction approach. Hence, it was important to select only those items that most closely purport to measure individualized instruction practices.

Earlier a definition for individualized instruction was presented. Five dimensions of individualized instruction were proposed: 1) the variety of content available; 2) the amount of content required; 3) the rates of learning expected; 4) the sequence of content provided; and 5) the variety of methods or activities used. With these criteria in mind, the IPQ items were classified by the investigator according to one or more of these dimensions, i.e., each item was coded as to which of the five dimensions they measured. Following this process, items were chosen from the instrument that measured the most dimensions or that measured dimensions infrequently measured by the other IPQ items. This process was repeated three months later by the investigator as a double check in the classification. All items were classified in the same manner as three months before, with the addition of one item.

The resultant questionnaire items, then, were chosen as the key IPQ items that best measured the five dimensions of indivdualized instruction. When responses on these items are summed, the score reflects the degree of indivdualized instruction being practiced by a given teacher. This score was used in this study as the means of classifying teacher practices, e.g., high individualized or low individualized (See Appendix H for the Key Items Classification).

2. Handling the missing data problem - Following the key punching of the teacher responses on the (IPQ) for both reading and mathematics, the data were inspected for missing responses. It was arbitrarily decided to drop all those teachers from the study who did not answer three or more of the eleven key IPQ items. As a result of this process, seven reading teachers and fourteen math teachers were eliminated from the subsequent analysis. Of the remaining reading teachers (N=298), 91.9% answered all eleven IPQ items, whereas 96.7% of the math teachers (N = 270) had no missing data.

In order to have all teachers with no missing data, a computer program was utilized to predict expected values for all missing responses. This program developed by the Broward County Research Department uses multiple regression to estimate the missing data points. An IBM 370, Model 145, was utilized to complete this task with both the reading and math teachers.

3. Reverse scoring IPQ items - One last adjustment in the data remained prior to beginning the analyses. In the original form the IPQ contained a mixture of positively stated items and negatively stated items. Hence, a computer program was utilized to transform the responses of negatively worded items (Items 2, 5, 17 and 21). This was accomplished

by reversing the scoring of the items so that low frequency-type responses to these negative items would be reflected more positively when the eleven key items were summed.

E. Results of the field test study. In order to determine the reliability of the eleven IPQ key items, a computer program from the Broward County Research Department was utilized. The estimate of reliability for the eleven items based on the responses of 298 reading teachers was .74 while the reliability for the 270 math teachers was .79. When the entire 29 item reading version of the IPQ was run the reliability was .73; whereas the reliability for the entire math version was .76. (It should be noted that not as much care was put into the wording of the items unique to reading and mathematics beyond the first 24 items common to both.)

A principal components analysis of the eleven key items resulted in every item loading on one common factor in the case of mathematics teachers and all but one item loading over .30 in the case of reading teachers. Table 3.2 summarizes these factor loadings in Appendix I.

In Table 3.3 the factor loadings for the 24 items common to both reading and math teachers are provided (See Appendix I). As can be seen, all items that were worded negatively in support of individualized instruction loaded separately on Factor 2, while positively stated items loaded positively on Factor 1. It should be noted that these results reflect the phrasing of the IPQ rather than distinct factors reflecting constructs of the instrument.

Even though the above principal components analyses were useful in exploring the factor structure of the eleven key items, the greatest use of the field test results came from inspecting the school means and teacher means and standard deviations of scores from the IPQ. After the negatively worded items were reversed and summed with the other key IPQ items for each teacher, the means and standard deviations were calculated using a computer program in the Nova University Computer Center. The mean score and standard deviation for the reading teachers were 36.8 and 6.3 respectively; whereas, for the math teachers the mean was 35.2 and the standard deviation, 6.7. When teachers were grouped by school, the mean for reading teachers was 37.3 with a standard deviation of 4.2. For the mathematics teachers, their school mean was 36.1 and the standard deviation, 4.9.

F. Selection of the schools for the study. Since it was not feasible to collect data from a randomly selected group of teachers from the county, schools were chosen as the unit of selection rather than teachers. This procedure facilitated the entire data collection process since so much personal contact with participants had to take place. In order to maximize the probability of getting differences on the criterion variable between high and low individualized settings, schools had to be selected according to carefully considered criteria. It was highly desirable to select schools, first of all, that could be clearly classified as high or low individualized. This was accomplished by inspecting the schools IPQ mean scores. Secondly, it was important that teachers within the school have low variability in their IPQ scores. Thus, the IPQ standard deviation of the teachers within the school became important statistics in this selection process.

In addition to considering the means and standard deviations, the type of school (open space or conventional) and number of teachers present in the school were important factors to be taken into account. It was desirable to have approximately an equal number of teachers in schools classified as high or low individualized. It was also desirable to have both open space and conventional schools represented in both categories if possible.

With the above considerations in mind, it was decided to divide the distribution of IPQ scores for schools into quartiles for both reading and mathematics. The standard deviations of teacher scores for each upper or lower quartile school were then inspected to see if the teachers within each school scored consistently high or low in terms of their degree of individualization. Finally, the ranking of each teacher within a school in comparison with the total teacher population was considered. This was an important step since a school would only need a reading mean score of 40 to be classified as high individualized in contrast to the other schools in the county. But to be classified as a high individualized teacher, a teacher would need a score of 42 or greater on the IPQ. Thus, the rankings of the teachers within the school in contrast to other county teachers also tempered the final selection of schools for the study.

Since only those teachers who were teaching science would actually be included in the investigation of the research questions, not all reading or mathematics teachers would also be teachers of science. Thus, the most important criterion for selection was the school's mean IPQ scores...the 'gamble' being that if a school operated high individualized programs in reading and mathematics, chances would be good for finding a high individualized science situation also; at least, chances would be better than if the schools were selected totally at random.

The seven schools eventually chosen were requested to have their fifth grade teachers of science complete both the IPQ and IATL, and give their students the Bristol and the Student Questionnaire.

For a listing of the seven schools, their IPQ means and standard deviations, see Table 3.4 and Table 3.5. Appendix J provides histograms of the IPQ scores for reading and mathematics. The location of each school chosen in the present study is also identified on each histogram.

G. Gathering the data from the schools

After county approval had been granted to conduct the study in selected schools, the Research Department arranged for appointments to be held between the principal of each school, the present investigator and a representative from the Research Office. Individual meetings were then held with each principal and the procedures for the study explained. A packet of all instruments and details for their administration were left with the principal (See Appendix K for an example). During the following week, the proper quantity of Student Questionnaires and Bristol tests with student identification labels were delivered to each of the seven schools. Most schools completed the testing phase of the study during the same week. During this time, students completed both the Bristol and Student Questionnaire. Each school was encouraged to give make-up exams to those students absent on the regular test day. The investigator personally picked up all instruments from each school.

Machine scoring of the Bristol was not possible due to the nature of the test format. All 903 Bristol tests were hand-scored by the investigator with the clerical assistance of aides associated with Nova University. Key punching of Bristol test results and the responses of the Student Questionnaire plus teacher instruments were completed at the Nova University Computer Center. Each school received lists of their students and their Bristol scores before the end of the school year with a letter

Table 3.4

Means and Standard Deviations of Seven Schools

Selected for the Study Based on Key IPQ Items

School	Number of Teachers	Reading		Mathematics	
		Mean	SD	Mean	SD
10	1	29.8	7.82	31.9	7.7
20	3	30.7	1.16	35.7	2.3
30	2	25.5*	5.34	26.6*	3.7
40	1	44.3	2.08	43.0	0.0
50	5	44.2	5.85	37.6	4.9
60	1	42.8	4.57	50.0	0.0
70	4	42.8	4.32	38.7	10.7

*Actual School means were slightly higher but figure shown in table reflects mean of only 2 teachers chosen for the study. Actual Reading mean was 26.1. Actual Mathematics mean was 26.6.

Table 3.5

School Rankings based on the Sum of Reading and Mathematics IPQ Scores

High Individualized Schools	Mean Total IPQ
School 60 (N=1)	92.8
School 40 (N=1)	87.3
School 50 (N=5)	81.8
School 70 (N=4)	81.5
Low Individualized Schools	**Mean Total IPQ**
School 20 (N=3)	66.2
School 10 (N=1)	61.7
School 30 (N=2)	52.1

of thanks for cooperating in the study. Appendix L includes an example of the materials distributed to the schools.

Finally, the investigator visited each school situation to familiarize himself with the physical resources, classroom organization, and science instructional practices. In many instances, conversations were held with teachers and children in the study. These conversations were mainly informal with the intent to gather information that could be used to clarify inconsistencies or discrepancies arising from subsequent analysis of the instruments.

Data Analysis

In order to investigate the research questions specified previously, the data analysis in the present study utilized multivariate analysis procedures. When possible, the analyses was conducted to control for nuisance variables that might confound the data interpretation. Efforts included taking into account the individual teacher effect on student performance. Similarly, contrasts of differences in student performance on the cognitive measure took into account parents' highest educational level attained.

After calculations of zero order correlations to determine the interrelationships of the major variables of interest, the data analysis was conducted on each of the research questions specified in the following manner:

(1) Are there significant differences in the levels of science cognitive attainment of children from high individualized science classes in contrast to children from low individualized science classes?

Since data from the five subtests of the Bristol were analyzed, multivariate analysis of covariance (MANCOVA)[1] served as the method of analysis. The five subtests of the Bristol served as the dependent variables, while parents' highest educational level was the covariate. Parents' educational level was utilized since IQ data was over two years old, having been collected when the students were in third grade. A number of other studies suggest that the socioeconomic status of the child's family is highly correlated with his performance on cognitive tests (See Plowden, 1967; Coleman, 1966; and Jencks, 1972). Consequently, it seemed important to utilize parents' highest educational level attained as a covariate in this analysis.

To determine the effect of the degree of individualized instruction on student performance on the dependent variables, teachers were classified into groups based on their science IPQ scores. The top one-third teachers were classified as high individualized, the middle third as medium individualized and the bottom one-third as low individualized.

In order to answer this first research question, the effect of each teacher was treated as a nuisance factor in the study. It was assumed that all children in a particular class had to conform equally to the degree of individualization reported by the teacher via the IPQ. The statistical analysis applied was hierarchical in design with the effect of teachers nested within the high-low individualized groups. The advantage of the nested design is that it isolates a source of variation that affects scores (Kirk, 1968, p. 229). The source of variation in the present study came from differences between teachers within the high and low individualized groups of teachers.

Using the nested design, a comparison between two groups was executed, i.e., a comparison of Bristol subtest means was made between classrooms classified as high individualized or low individualized.

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[1] See Cooley and Lohnes (1971) for a description of this analysis.

(2) Are there significant differences in the science related cognitive attainment of children experiencing only high individualized programs in open space schools vs. children experiencing only high individualized programs in conventional schools?

A multivariate analysis of covariance (MANCOVA) was used for this analysis with only students of those teachers in the upper third of the IPQ used in the analysis. The students were then divided into open space and conventional school groups prior to testing for cognitive differences.

Scores from the Bristol subtests were again used as dependent variables in the MANCOVA analysis. Also, since parent educational level was known, the variance associated with this variable was removed from the analysis.

(3) What is the correlation between the degree of individualized instruction and teachers' open classroom philosophy?

Zero order correlations was used to describe the magnitude of this relationship.

(4) What relationships exist between teachers' open classroom philosophy and their respective class distributions of cognitive scores?

Besides simple zero order correlations being reported for this question, a somewhat less common analysis was also performed. This analysis included the entering, by class, of four descriptors of the distribution of the two cognitive instruments as predictors into a multiple regression program with the IATL as the criterion. This technique, reported by

Cooley (1971), has the advantage of determining whether there are characteristics of the distribution that are useful in predicting a given criterion. The four descriptors of the distribution, the mean, standard deviation, skewness and kurtosis, of the total Bristol score were included in the predictor set.

(5) Are there significant differences in the science cognitive attainment of children within various subgroups experiencing either open space or conventional school instruction?

The analysis of this question utilized MANCOVA in a 2 X 2 X 2 factorial design with five criterion measures and one covariate. The five criterion measures included the five Bristol subscores; the covariate was again the parents' educational level. The factors entered consisted of sex, race, and type of school.

Chapter Four

Results of the Data Analysis

Descriptive Analyses

Before initiating a comprehensive analysis of the research questions, the data were explored for similarities and differences that might best describe the nature of the groups involved in the study. Since two distinct groups, teachers and students, were involved in the present study, accounts describing their unique characteristics will be provided separately following a description of the schools.

Descriptive Information Relative to Schools

Of the seven schools participating in the study three were conventionally constructed, i.e., with separate classrooms and hallways. Four of the schools were of open space design. One of the seven schools conducted their fifth grade science program in a series of portable classrooms and was thus classified as a conventionally constructed school.

The seven schools participating in the study were located in six different communities in the county; namely, Fort Lauderdale, Hollywood, Miramar, Davie, Plantation and Pompano Beach. The mean coded value for parents' highest educational level for all schools was 5.5, indicating that the average parent educational background for a given school included some college (see Appendix E for this coding). The range of mean values on parents' educational level across schools spanned from a low of 4.5 to a high of 6.6. The percent of known black students in all schools tested was 15%, the range across the schools being from 0% to 43%. For a summary of the descriptive data on the schools, see Table 4.1.

Table 4.1

Descriptive Data on Schools

School	Type Construction*	Parent Educ. Level	Percentage White	No. Teachers	No. Students
10	C	4.5	96	1	242
20	OS	6.2	81	3	154
30	C	4.7	77	2	51
40	C	5.2	57	1	88
50	OS	5.1	78	5	128
60	OS	6.2	100	1	113
70	OS	6.6	94	4	127

*Type Construction:

C = conventional school construction (rooms and hallways)
OS= open space construction

Descriptive Information Relative to Teachers

Thirteen of the seventeen teachers in the study were teaching in open space schools. One of the four teachers assigned to a conventional school was a "floater-teacher" moving every half-hour from one portable classroom to another.

The average number of years teaching experience for the seventeen teachers was 6.6 years, while the average number of years in their present situation was three to six years. In terms of the teachers' background in science, eight teachers had two or less science courses to their credit. Six teachers had more than seven years of science teaching experience. For a summary of the biographical information on the teachers see Table 4.2.

Table 4.2

Biographical Information on the Teachers

Teacher No. & Type School	Years Experience	Years Teaching Science	Years in Present Situation	Number of Science Courses
11 C	--	3-6	0-2	--
21 OS	6	0-2	1 1/2	1
22 OS	--	0-2	3-6	1
23 OS	6	3-6	1	--
31 C	12	7+	1	1
32 C	3	0-2	1	1
41 C	13	7+	13	2
51 OS	1 1/2	0-2	1	5
52 OS	3	3	1	6
53 OS	3 1/2	0-2	3 1/2	4
54 OS	7	7	3	4
55 OS	7	7+	3	5
61 OS	14	7+	1	7
71 OS	2	0-2	2	1
72 OS	4	3-6	4	1
73 OS	14	7+	4	2
74 OS	4	3-4	4	7
Average	6.6	3-6	3-6	3.2

C = Conventional School Contruction (rooms & hallways)
OS = Open Space Contruction

Scores on the science Instructional Practices Questionnaire (IPQ) for the seventeen teachers ranged from 21-48 with a mean of 36 and a standard deviation of 6.98. These scores, indicating the degree of individualization in science, were based on scores from the eleven Key Item scoring procedure described in the previous chapter. The correlation between these eleven items and scores on the entire thirty item science instrument was +.89.

The scores on the instrument, Ideas About Teaching and Learning (IATL), ranged from 114-196. The score, based on the sums of the items, indicates teacher beliefs in support of open classroom ideas. The mean score for the seventeen teachers on the IATL was 166.1; the standard deviation was 20.6. A low negative correlation existed between the IPQ and IATL, i.e., r = -.15. An inspection of Table 4.3 indicates that one particular teacher had a substantially low IATL score in contrast to a high IPQ score. Teacher # 74, being classified as high individualized, actually scored the lowest of all teachers on the IATL. The intercorrelations between IPQ and the IATL were recomputed with Teacher # 74 deleted from the analysis. The correlation was basically the same as before, i.e., r = -.10. This indicated that this one teacher was not substantially affecting the overall correlation between the IPQ and IATL.

As previously indicated, the mean parents' highest educational level was calculated for each school. These data and the percentage of white students in a given classroom are listed with other descriptive teacher data in Table 4.3.

An intercorrelation analysis between all major teacher variables and class performance on the Bristol is provided in Table 4.4. A further description of class performance on the Bristol will be provided in the next section.

Table 4.3

Descriptive Data Relevant to Teachers Ranked by IPQ Scores

Teacher	IPQ Score	IATL	PEL	% White
71	48	175	6.6	97
72	47	132	6.6	94
73	44	163	6.6	90
61	41	178	6.2	100
54	41	196	5.1	89
74	39	114	6.6	96
41	39	170	5.2	55
52	38	154	5.1	77
21	37	173	6.2	83
51	34	156	5.1	70
55	33	160	5.1	94
22	32	194	6.2	80
31	31	169	4.7	82
23	30	191	6.2	90
53	29	170	5.1	57
11	28	179	4.5	96
32	21	150	4.7	70
Total $\bar{x}$	36	166.1	5.6	83.5

IPQ - score measures degree of individualized instruction
IATL - score measures open classroom beliefs
PEL - parents' highest educational level - school average
% White - percentage of white students in classroom

Table 4.4

Intercorrelation Analysis of Teacher Data

(N=17)

	IPQ	IATL	PEL	% WHITE	BRISTOL
IPQ	1.00	-0.15	0.67	0.41	0.61
IATL		1.00	-0.17	-0.04	-0.15
PEL			1.00	0.47	0.89
% WHITE				1.00	0.68
BRISTOL					1.00

IPQ = score measures degree of individualized instruction
IATL = score measures open classroom beliefs
PEL = parents' highest education level - school average
% WHITE = percentage of white students in classroom
BRISTOL = score measures science related cognitive skills - classroom means

The amount of science materials available and utilized by the teachers in the seven schools varied greatly. One situation observed had a great diversity of materials being utilized in a sophisticated laboratory setting; whereas another situation was observed in which no manipulative materials were evident, only printed material. In one school, Learning Activity Packages (LAPS) were being utilized by individual students with kits of investigations prepared and updated by student lab assistants. Several schools had recently completed local science fairs in which students explored projects on their own or in small groups.

Descriptive Information Relative to Students

In all, 903 fifth grade students completed the Bristol Test. Appendix M provides a histogram of individual students' scores on the Bristol. The distribution of Bristol total scores ranged from 1-45 with a mean of

25.7 and a standard deviation of 9.3. The standard error of the estimate was 0.31. Appendix M summarizes the distribution of student scores on each of the five parts of the Bristol. Of the 903 studnets, 58 failed to submit the Student Questionnaire (SQ); this was due mainly to two schools having had students complete the forms on separate days. Classroom mean scores for those students who did complete the SQ were calculated for each classroom and subsequently used in validating the IPQ. The correlation between the SQ classroom mean scores and teachers' IPQ score was +.47; this was a moderate relationship pursuant to validation of teachers' self-reports of instructional practice. The mean scores for all classes on the Bristol and the SQ are provided in Table 4.7. Other data characterizing the Bristol distributions for each classroom are also provided in Table 4.7; for instance, the measures of skewness and kurtosis are provided. The calculation for the skewness values are based upon the formula:

$$\frac{(Q_3 - Q_2) - (Q_2 - Q_1)}{Q_3 - Q_1} = \text{Quartile coefficient of skewness}$$

The value for kurtosis involves substituting the scores located at the tenth and ninetieth percentiles in the formula:

$$K = \frac{Q}{P_{90} - P_{10}}$$

$$\text{when} \qquad Q = 1/2\ (Q_3 - Q_1)$$

Since the major unit of analysis in this study was the teacher and his or her corresponding data, the mean scores for all parts of the Bristol were calculated for all students assigned to each teacher. These

Table 4.7

Student Data Compared to Teacher IPQ Scores

Teacher	Bristol Mean	Bristol S.D.	Bristol Skewness	Bristol Kurtosis*	Student Questionnaire	IPQ
11	24.2	8.6	-.04	.26	11.1	28
21	28.9	10.0	-.30	.23	10.4	37
22	27.0	8.7	-.02	.27	10.8	32
23	29.1	9.0	-.12	.30	11.1	30
31	23.7	9.2	-.41	.33	11.1	31
32	20.4	9.8	+.01	.35	11.9	21
41	22.9	9.9	+.03	.31	11.4	39
51	19.7	9.5	-.45	.29	11.0	34
52	22.7	8.1	+.26	.30	11.3	38
53	18.7	9.1	+.30	.35	11.8	29
54	22.4	10.7	+.44	.31	9.5	41
55	22.9	10.6	+.10	.28	10.9	33
61	28.1	7.8	-.16	.27	11.2	41
71	30.0	6.8	+.23	.22	14.3	48
72	30.4	6.6	+.21	.16	13.8	47
73	32.2	7.4	-.01	.35	13.6	44
74	31.2	7.6	-.03	.18	14.3	39

*Kurtosis value for a normal distribution = 0.263

are provided in Table 4.8 along with Bristol total scores. An intercorrelation analysis between all parts of the Bristol resulted in correlations ranging from .50 to .64. The complete intercorrelation analysis is provided in Table 4.9.

Preparing the Data for Analyses of the Research Questions

Two major problems had to be resolved before data analysis could begin. The first problem concerned missing data such as non-responses to questionnaire items. The second problem focused upon how to ensure that students in the analysis had not recently enrolled in any of the classrooms in the study.

In handling the missing data problem, each variable had to be considered individually on its own particular characteristics. Of the data from the student instruments, there were no missing data on the Bristol. Only 17 students were missing one or more responses to the SQ. The mean for each questionnaire item per class was calculated and substituted for missing responses. After scores on the negatively worded items were reversed, a total was calculated by summing item responses.

For the parents' educational level (PEL) the mean of the school was assigned to students having missing data points. Since 176 students lacked PEL information, a one-way analysis of variance was run on each school to see what Bristol test differences existed between students with PEL information and students without PEL information. As can be seen in Table 4.10, differences were significant in the case of two of the seven schools.

Handling missing teacher data by substituting group means was not justifiable, since each teacher's response presumably would be unrelated to any group responses. For any missing responses, it was decided that

Table 4.8

Means and Standard Deviations on the Bristol Parts and Total Score*

Schools/Teachers		Part I	Part II	Part III	Part IV	Part V	Total
School 1 Pooled Results	$\bar{X}$	6.6	6.0	3.8	3.2	4.6	24.2
	SD	2.6	2.8	1.7	1.5	2.3	8.6
Teacher 11 (N=242)	$\bar{X}$	6.6	6.0	3.8	3.2	4.6	24.2
	SD	2.6	2.8	1.7	1.5	2.3	8.6
School 2 Pooled Results	$\bar{X}$	7.9	6.6	4.5	3.7	5.6	28.4
	SD	2.7	3.1	1.8	1.6	2.0	9.3
Teacher 21 (N=51)	$\bar{X}$	8.0	6.5	4.7	3.8	5.9	28.9
	SD	2.8	3.2	2.0	1.6	2.1	10.0
Teacher 22 (N=50)	$\bar{X}$	7.4	6.1	4.4	3.5	5.6	27.0
	SD	2.8	2.7	1.8	1.7	2.0	8.7
Teacher 23 (N=53)	$\bar{X}$	8.2	7.2	4.4	3.9	5.3	29.1
	SD	2.4	3.3	1.7	1.5	2.0	9.0
School 3 Pooled Results	$\bar{X}$	6.2	5.1	3.5	3.0	4.3	22.1
	SD	2.4	3.2	2.1	1.7	2.0	9.5
Teacher 31 (N=26)	$\bar{X}$	6.7	5.5	3.7	3.3	4.5	23.7
	SD	2.5	3.0	2.2	1.5	1.9	9.2
Teacher 32 (N=25)	$\bar{X}$	5.6	4.6	3.2	2.8	4.2	20.4
	SD	2.3	3.3	2.0	1.8	2.1	9.8
School 4 Pooled Results	$\bar{X}$	6.8	5.7	3.4	2.8	4.1	22.9
	SD	2.7	2.9	1.9	1.9	2.5	9.9
Teacher 41 (N=88)	$\bar{X}$	6.8	5.7	3.4	2.8	4.1	22.9
	SD	2.7	2.9	1.9	1.9	2.5	9.9

Table 4.8 (continued)

Means and Standard Deviations on the Bristol Parts and Total Score*

Schools/Teachers		Part I	Part II	Part III	Part IV	Part V	Total
School 5 Pooled Results	$\bar{X}$	6.4	4.9	3.4	2.8	3.6	21.1
	SD	2.7	2.9	1.9	1.8	2.2	9.4
Teacher 51 (N=26)	$\bar{X}$	6.3	4.5	3.0	2.5	3.9	19.7
	SD	2.7	3.2	2.2	1.9	2.0	9.5
Teacher 52 (N=34)	$\bar{X}$	6.8	5.4	3.8	2.6	4.1	22.7
	SD	2.9	2.7	1.8	1.3	2.1	8.1
Teacher 53 (N=31)	$\bar{X}$	5.7	4.0	3.0	2.5	3.3	18.7
	SD	2.7	2.7	2.0	1.5	2.0	9.1
Teacher 54 (N=20)	$\bar{X}$	6.6	5.2	3.4	3.5	3.8	22.4
	SD	2.7	3.1	1.6	2.2	2.8	10.7
Teacher 55 (N=17)	$\bar{X}$	7.0	5.8	3.8	2.8	3.4	22.9
	SD	2.4	3.1	2.0	2.2	2.3	10.6
School 6 Pooled Results	$\bar{X}$	7.6	6.7	4.6	3.7	5.5	28.1
	SD	2.3	3.0	1.7	1.5	1.9	7.8
Teacher 61 (N=113)	$\bar{X}$	7.6	6.7	4.6	3.7	5.5	28.1
	SD	2.3	3.0	1.7	1.5	1.9	7.8
School 7 Pooled Results	$\bar{X}$	8.8	7.3	4.7	4.3	5.7	30.9
	SD	2.0	2.6	1.5	1.4	1.9	7.1
Teacher 71 (N=36)	$\bar{X}$	8.9	7.1	4.2	4.3	5.5	30.0
	SD	2.0	2.5	1.5	1.4	1.8	6.8
Teacher 72 (N=33)	$\bar{X}$	9.1	6.7	4.7	4.4	5.5	30.4
	SD	1.9	2.8	1.6	1.3	2.2	6.6

Table 4.8 (continued)

Means and Standard Deviatons on the Bristol Parts and Total Score*

Schools/Teachers		Part I	Part II	Part III	Part IV	Part V	Total
Teacher 73 (N=29)	$\overline{X}$	9.0	7.8	5.0	4.3	6.1	32.2
	SD	2.0	2.4	1.5	1.6	2.1	7.4
Teacher 74 (N=29)	$\overline{X}$	8.5	7.8	5.0	4.2	5.7	31.2
	SD	2.2	2.7	1.5	1.6	1.7	7.6
Total Results (N=903)		7.2	6.2	4.0	3.4	4.8	25.7
Standard Deviation		2.7	3.0	1.8	1.7	2.3	9.3
Standard Error		0.09	0.10	0.06	0.06	0.08	0.31

*Scores listed are for all students prior to eliminating some students from future analysis due to not being enrolled with a given teacher in the study for an adequate period of time.

Table 4.9

Intercorrelation Analysis of Student Performance on the Five Parts of the Bristol (N=817)

Bristol Subtest	Properties I	Structures II	Processes III	Explanations IV	Interpretations V
I Properties	1.00	0.60	0.64	0.59	0.59
II Structures		1.00	0.57	0.50	0.54
III Processes			1.00	0.54	0.56
IV Explanations				1.00	0.55
V Interpretations					1.00

Table 4.10

Analysis of Variance Contrasting Students with and without Parent Educational Level Data

School		$\bar{X}$ Bristol Score	P-value
School 10:	PEL (N=202)	23.7	
	Non PEL (N=40)	26.7	$p < .05$
School 20:	PEL (N=125)	30.0	
	Non PEL (N=29)	21.2	$p < .01$
School 30:	PEL (N=40)	21.9	
	Non PEL (N=11)	22.8	$p > .05$
School 40:	PEL (N=29)	22.6	
	Non PEL (N=59)	23.0	$p > .05$
School 50:	PEL (N=103)	21.7	
	Non PEL (N=25)	18.5	$p > .05$
School 60:	PEL (N=107)	28.3	
	Non PEL (N=6)	24.6	$p > .05$
School 70:	PEL (N=121)	31.1	
	Non PEL (N=6)	26.0	$p > .05$

the best estimate of a given teacher's unanswered item would be the mean score from the other items completed by that teacher on the instrument concerned. Four teachers required item substitutions for one or more missing responses on the IPQ; three teachers had one or more missing responses on the IATL.

The second major problem before data analysis could begin was determining a method to control the duration of the treatment, i.e., the length of time students experience the reported mode of instruction. A strategy was needed that would eliminate from the analysis those students who had recently enrolled in a given teacher's class. It was decided that if a student did not have a county assigned Student Identification (SID) number, then he would be dropped from the analysis. Since a November listing of SID numbers was available, this proved to be an effective means of identifying which students were enrolled prior to November. This procedure was used to eliminate 86 students from the analysis that entered county schools after November, the third month of the school year. Hence, all students in all subsequent analyses had been under the effect of a reported instructional practice for at least seven school months.

Results of Statistical Analyses to Answer the Research Questions

Question 1. Are there significant differences in the levels of science cognitive attainment of children from high individualized science classes in contrast to children from low individualized science classes?

Results of the data from the five subtests of the Bristol were analyzed using multivariate analysis of covariance (MANCOVA). But prior to this analysis, classrooms had to be classified into groups according to the degree of individualized instruction being utilized. Since student data from only seventeen teachers were available, a problem existed as to the proper cut-off points for high and low individualized groups. For example, cut-off points of ±1 standard deviation would result in 66% of the classrooms not being utilized in the analysis if the distribution was normal. It was decided to divide the teachers into thirds based on their IPQ scores. By so doing, high and low individualized groups could be contrasted with only one third of the teachers being excluded from the analysis. As it turned out only 116 students were eliminated in this process since seven teachers were classified as high individualized and six teachers were classified as low individualized. With the deletion of 86 students due to having enrolled within the seven month treatment period, 701 students were subsequently utilized in this analysis. A total of 321 students were being taught in high individualized science classes, while 380 students came from low individualized classrooms.

The Bristol subtest means and standard deviations for students coming from high individualized classrooms and low individualized classrooms are provided in Table 4.11. As indicated in the table, high individualized students attained higher mean scores on every part of the Bristol test. To assess whether these scores were actually significantly different between the groups, a multivariate analysis of covariance (MANCOVA) was performed with parents' educational level (PEL) as a covariate.

To assess usefulness of this variable as a covariate, a test of within cells regression was included in the MANCOVA output. An F-ratio of 6.3 (df = 5, 683) was significant beyond the .001 level. This indicated that PEL was significantly related to the criterion variables, i.e., the five subtests of the Bristol. Hence, PEL was regarded as a useful covariate in the analysis of this research question.

Table 4.11

Bristol Means and Standard Deviations for Students From Classrooms Differing in the Degree of Individualized Instruction

Bristol Subtest		High Individualized (N=321)	Low Individualized (N=380)*
I. Properties	M	7.9	6.7
	SD	2.5	2.7
II. Structures	M	6.6	5.9
	SD	2.9	3.0
III. Processes	M	4.3	3.8
	SD	1.7	1.8
IV. Explanations	M	3.7	3.2
	SD	1.7	1.6
V. Interpretations	M	5.2	4.7
	SD	2.2	2.2
Total Bristol	M	27.7	24.3
	SD	8.8	9.2

*It should be noted that 242 Ss from one conventionally constructed school were included in the low individualized group. The importance of reliable responses from the one teacher responsible for these students cannot be taken lightly. Informal observations at the school by the investigator were used to substantiate the classification.

Included in the multivariate analysis of covariance output for this first question was a test for significant differences in the unique variance associated with each teacher within the high and low individualized groups. The overall results produced an F-ratio = 2.3, $p < .001$. The univariate tests resulted in significant differences between teachers ($p < .01$) in all five instances. These significant differences that existed between classrooms on the Bristol subtests, suggested that unique effects between teachers or classrooms were operating in the present situation. The nested design chosen for the analysis of this research question subsequently partitioned this variance from the error variance, the results of which are reported below.

The multivariate test of overall Bristol differences between high and low individualized classrooms was significant (F-ratio = 5.3, df = 5, 683) beyond the .001 level. The result, favoring high individualized classrooms, controlled for parents' educational level and unique teacher effects. The univariate tests indicated that students from high individualized classrooms scored significantly higher on the first four of the five Bristol subtests. The F-ratios and p values for each of the Bristol parts are provided in Table 4.12.

In an analysis of covariance applied to the test data of both racial groups, white students in high individualized situations did significantly better ($p < .05$) than white students in low individualized settings on Parts I, II and III and on the total Bristol score. But for blacks in high vs. low individualized settings, it was found that even though high individualized blacks scored higher on every subtest and on the total Bristol, the differences between the groups were nonsignificant ($p > .05$).

Table 4.12

Multivariate and Univariate Tests of Significance
Contrasting High vs. Low Individualized Groups

Bristol	Univariate F-ratios (1, 687 df)	P Less Than
Properties	21.5	.001
Structures	8.2	.004
Processes	7.1	.008
Explanations	14.0	.001
Interpretations	2.7	.099

MANOVA F-ratio = 5.3, df = 5, 683

Question 2. Are there significant differences in the science related cognitive skill attainment of children experiencing only high individualized programs in open space schools vs. children experiencing only high individualized programs in conventional schools?

The original design to explore this question was to analyze the data similarly to question one. However, since only one group of students from a conventionally constructed school was classified as high individualized, insufficient degrees of freedom made the nested design inappropriate. Instead, the basic multivariate analysis of covariance procedure was utilized. Two groups were contrasted in the analysis: students from high individualized open space schools and students from high individualized conventionally constructed schools. This analysis was conducted with the Bristol subtests as the dependent variables, and with PEL used as the covariate. The multivariate test of overall Bristol differences between the two types of schools was significant (F-ratio=5.8, df=5, 314) beyond the .001 level. Significant differences ($p < .05$) were detected favoring high individualized open space schools on all five subtests. The F-ratios for the univariate tests ranged from 5.2 to 21.0 (df = 1, 318). Table 4.13 summarizes these results.

Table 4.13

Multivariate[1] and Univariate Tests Contrasting High Individualized Open Space Students vs. High Individualized Conventional Students

Bristol Subtest	Univariate F-ratios	P Less Than
Properties	5.2	.023
Structures	7.1	.008
Processes	21.0	.001
Explanations	17.4	.001
Interpretations	11.2	.001

Question 3. What is the correlation between the degree of individualized instruction and teachers' open classroom philosophy?

As reported earlier in this chapter, the correlation between the IPQ and the IATL was -.15. It was also reported earlier that the elimination of one teacher from the analysis due to a questionable low score did not effect the correlation coefficient substantially. Thus, only a slight negative relationship existed between the responses of the seventeen teachers on the instrument measuring the degree of individualized instruction and their beliefs supporting the open classroom ideology.

Question 4. What relationships exist between teachers' open classroom philosophy and their respective class distribution of cognitive scores?

Earlier in Table 4.7 various measures of central tendency were reported for each teacher's class scores on the Bristol. Specifically,

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[1] MANOVA F-ratio = 5.8, (df = 5, 314), $p < .001$

Bristol means, standard deviations, skewness and kurtosis were listed for each teacher. Prior to executing multiple regression analysis, intercorrelations between Bristol means, standard deviations, skewness, kurtosis and IATL scores were computed. Results of this analysis are provided in Table 4.14.

Table 4.14

Intercorrelation Analysis of Bristol Distribution Information and Teachers' Open Classroom Philosophy

		1	2	3	4	5
1	Bristol Means	1.00	-0.66	0.16	-0.59	-0.15
2	Bristol S.D.		1.00	0.00	0.50	0.37
3	Bristol Skewness			1.00	-0.10	0.00
4	Bristol Kurtosis				1.00	0.42
5	IATL Score					1.00

The Bristol means, standard deviations, skewness and kurtosis were the elements in the predictor set of the multiple regression analysis used in exploring this question. The full model included all four measures of central tendency with teacher's score on Ideas About Teaching and Learning as the criterion variable. The analysis resulted in a multiple R value of 0.53 or $R^2 = .28$. When this full model was tested for significance, the resulting F-ratio was non-significant. When each element of the entire predictor set was separately dropped out of the model and tested against the full model none of the measures of central tendency was significant.

Question 5. Are there significant differences in the cognitive attainment of children within various subgroups experiencing either open space or conventional school instruction?

The means and standard deviations for the eight subgroups on the five parts of the Bristol and the total are provided in Table 4.15. As can be observed in Table 4.15, the mean scores on the first Bristol subtest, Properties, range from 8.2 for both white boys and white girls coming from open space schools to 4.3 for black boys in open space schools. For the second Bristol subtest, Structures, the range of mean scores is from 6.9 for white boys in open space schools to 3.2 for black girls in conventional schools. On the third subtest, Processes, again white open space boys had the highest mean score with 4.7, while black boys from open space schools were low with a mean score of 1.8. The highest mean score on the fourth Bristol subtest, Explanations, was 3.9, scored by both white boys and white girls from open space schools. Black girls from conventional schools scored lowest on Explanations with a mean score of 1.4. Highest performance on the last Bristol subtest, Interpretations, was by white girls from open space schools, with a mean score of 5.6. The lowest mean score on Interpretations was attained by black girls from conventional schools at 2.4.

The major analysis of this question was a 2 x 2 x 2 multivariate analysis of covariance (MANCOVA) with sex, race and type of school identified as the factors. The dependent variables in the analysis consisted of the five Bristol subtests with parents' educational level used as the covariate.

The results of the first MANCOVA analysis for this question are reported in Table 4.16. In all instances, except in the case of race and school, the interactions were nonsignificant ($p > .05$). In the race-school interaction test, the resultant F-ratio of 2.7 was significant ($p < .05$).

Table 4.15

Science Related Cognitive Skill Scores for Various Groups as Measured by the Bristol Test

Group		Part I	Part II	Part III	Part IV	Part V	Total
White Girls - OS	M	8.2	6.8	4.6	3.9	5.6	28.9
(N=225)	SD	2.2	2.8	1.5	1.5	1.9	7.5
White boys - OS	M	8.2	6.9	4.7	3.9	5.3	28.8
(N=212)	SD	2.3	3.0	1.8	1.6	2.2	8.7
White girls - C	M	7.1	6.0	3.7	3.2	4.9	24.9
(N=139)	SD	2.6	2.6	1.7	1.5	2.2	7.9
White boys - C	M	6.5	6.2	3.9	3.3	4.6	24.4
(N=134)	SD	2.7	3.1	1.7	1.5	2.4	9.4
Black boys - C	M	5.2	4.1	2.6	1.8	2.9	16.6
(N=22)	SD	2.1	2.6	1.5	1.6	2.0	6.2
Black girls - OS	M	4.8	3.3	2.5	1.7	3.2	15.4
(N=24)	SD	2.3	1.9	1.4	1.2	2.2	6.8
Black boys - OS	M	4.3	3.6	1.8	1.9	3.1	14.8
(N=32)	SD	2.7	2.9	1.7	1.6	2.3	8.3
Black girls - C	M	4.7	3.2	1.9	1.4	2.4	13.7
(N=29)	SD	2.5	2.4	1.5	1.2	1.7	6.3

OS = Open space schools
C = Conventionally constructed schools

Part I = Properties
Part II = Structures
Part III = Processes
Part IV = Explanations
Part V = Interpretations

Table 4.16

MANCOVA Test of Interaction Contrasting Science Related Cognitive Skills in Subgroups of Sex, Race and School

Source	F-ratio	P Less Than
Sex X Race X Type of School	0.92	.471
Race X Type of School	2.67	.021
Sex X Type of School	1.38	.230
Sex X Race	0.87	.501

In order to further investigate the multivariate race-school interaction, univariate F-ratios were inspected to identify which variables of the Bristol were major contributors to the significant interaction. Table 4.17 summarizes the results of these univariate tests. An inspection of the univariate tests indicates that the mean scores of two of the five Bristol subtests, Properties and Processes, when adjusted for the covariate, were significantly different ($p < .05$) between blacks and whites attending the two different types of schools. Table 4.18 summarizes the adjusted mean scores on all the Bristol subtests between the two racial groups in open space and conventionally constructed schools.

Table 4.17

Univariate F Tests on Bristol Subtests for School and Race Interaction

Variable	F-ratio	P Less Than
Properties	7.4	.007
Structures	0.7	.419
Processes	4.0	.045
Explanations	0.7	.392
Interpretations	0.2	.666

Manova F-ratio = 2.7, (df = 5, 804), $p < .05$

Table 4.18

Means, Adjusted Mean Scores and Standard Deviations on the Bristol Subtests by School and Race

Group		Part I	Part II	Part III	Part IV	Part V
White Students-OS	M	8.2	6.8	4.6	3.9	5.4
(N=437)	AM*	7.9	6.5	4.5	3.8	5.2
	SD	2.2	2.9	1.6	1.5	2.1
White Students-C	M	6.8	6.1	3.8	3.3	4.8
(N=273)	AM*	7.1	6.5	3.9	3.4	5.0
	SD	2.7	2.8	1.7	1.5	2.3
Black Students-OS	M	4.5	3.5	2.1	1.8	3.2
(N=56)	AM*	4.7	3.7	2.2	1.9	3.3
	SD	2.5	2.6	1.6	1.4	2.2
Black Students-C	M	4.9	3.6	2.2	1.6	2.6
(N=51)	AM*	5.3	4.0	2.4	1.7	2.9
	SD	2.3	2.5	1.5	1.4	1.8

AM* = Adjusted Mean Scores
N = 817; Ss enrolled after November were eliminated from the analysis

Part I = Properties
Part II = Structures
Part III = Processes
Part IV = Explanations
Part V = Interpretations

OS = Open Space Designed Schools
C = Conventionally Constructed Schools

An analysis of covariance was applied to the total Bristol scores in the four groups (i.e., white students from conventional schools; white students from open space schools; black students from conventional schools; and black students from open space schools). The univariate F test contrasting total Bristol means yielded an F-ratio of 56.7 which was significant ($p < .001$). The means and adjusted means derived from analysis of covariance are presented in Table 4.19.

Table 4.19

Science Related Cognitive Skill Attainment of Various Subgroups with Effects of Parents' Highest Educational Level Removed

School Facility/Race	Covariate Mean	Bristol Mean	Adjusted Means*
Open Space/Whites	6.2	28.9	27.9
Conventional/Whites	4.7	24.7	25.9
Open Space/Blacks	4.9	15.0	15.9
Conventional/Blacks	4.6	14.9	16.3

*Univariate F-ratio = 56.7, (df = 3, 815), $p < .001$

In addition to the tests for interaction effects, the MANCOVA output provided tests for the various main effects of race, school and sex. The multivariate test of main effect of type of school (open space vs. conventional) was significant (F = 4.6, df = 5, 804) at the .001 level. Even though this result might suggest that children from open space schools scored significantly higher than conventional school children, this result still needs to be interpreted in light of the significant race-school interaction.

Analysis of covariance (ANCOVA) was then applied to each of the five subtests to pinpoint adjusted mean score differences between types of schools. This analysis detected significant differences on three Bristol subtests: Properties, Processes and Explanations. The highest adjusted mean values were scored by children from the open space schools in every instance except on Part II, Structures. Table 4.20 provides a summary of the results contrasting type of schools.

Table 4.20

Analysis of Covariance Contrasting Science Related Cognitive Skills in Different Types of Schools

Type School		Part I	Part II	Part III	Part IV	Part V
Open Space Facility	M	7.8	6.5	4.4	3.6	5.2
(N=493)	AM*	7.5	6.1	4.2	3.5	4.9
	SD	2.6	3.0	1.8	1.7	2.2
Conventional Facility	M	6.5	5.7	3.5	3.0	4.4
(N=324)	AM*	7.0	6.2	3.8	3.2	4.8
	SD	2.7	2.9	1.8	1.6	2.3
Univariate F-tests		6.1	.03	7.7	5.5	.94
p-values		<.01	ns	<.01	<.05	ns

AM* = adjusted means
ns = nonsignificant
Part I = Properties
Part II = Structures
Part III = Processes
Part IV = Explanations
Part V = Interpretations

The multivariate test of the main effect of race was significant (F=38.8, df = 5, 804) beyond the .001 level. Still these results must be placed in proper perspective. The interaction suggests that the influence of racial group membership on the Bristol is dependent on the effects of the type of school. Very large F ratios resulted when univariate F tests were computed from students' adjusted mean scores on each of the

Bristol subtests. Results from a one-way analysis of covariance demonstrated that white students scored significantly ($p < .001$) higher than black students on every subtest. Table 4.21 summarizes the results of the science related cognitive attainment of black and white students in the study.

Table 4.21

Analysis of Covariance Contrasting

Science Related Cognitive Skills in Racial Groups

Racial Groups		Part I	Part II	Part III	Part IV	Part V
White	M	7.7	6.6	4.3	3.6	5.2
(N=710)	AM*	7.6	6.5	4.3	3.6	5.1
	SD	2.5	2.9	1.7	1.6	2.2
Black	M	4.7	3.5	2.2	1.7	2.9
(N=107)	AM*	5.1	3.9	2.4	1.8	3.2
	SD	2.4	2.5	1.5	1.4	2.1
Univariate F-tests		100.1	81.3	120.4	124.9	77.4
p-values		<.001	<.001	<.001	<.001	<.001

AM* = adjusted means
Part I = Properties
Part II = Structures
Part III = Processes
Part IV = Explanations
Part V = Interpretations

A multivariate test of the effects of sex across all parts of the Bristol test produced small but significant differences. This overall test favored females with an F-ratio of 2.5 and p-value <.05. An inspection of the univariate F tests on each subtest of the Bristol revealed no significant differences between girls and boys on any of the subtests. Results of this analysis is provided in Table 4.22.

Table 4.22

Analysis of Covariance Contrasting Sex Differences in Science Related Cognitive Skill Attainment

Sex Group		Part I	Part II	Part III	Part IV	Part V
Female	M	7.4	6.1	4.0	3.3	5.0
(N=417)	AM*	7.4	6.1	4.0	3.3	5.0
	SD	2.6	2.9	1.8	1.6	2.2
Male	M	7.2	6.2	4.1	3.4	4.7
(N=400)	AM*	7.2	6.2	4.1	3.4	4.7
	SD	2.8	3.2	1.9	1.7	2.3
Univariate F tests		1.3	0.5	0.1	0.7	3.0
p-values		ns	ns	ns	ns	ns

AM* = adjusted means
ns = nonsignificant
Part I = Properties
Part II = Structures
Part III = Processes
Part IV = Explanations
Part V = Interpretations

Table 4.23

Summary of Bristol Total Score Means and Adjusted Means by Various Subgroups

		BLACKS		WHITES		
		Open Space	Conventional School	Open Space	Conventional School	Means
Males	M	14.8	16.6	28.8	24.4	25.6
	AM	(14.6)	(16.9)	(27.9)	(25.9)	(25.6)
Females	M	15.4	13.7	28.9	24.9	25.8
	AM	(15.2)	(13.9)	(28.2)	(26.3)	(25.8)
Total Means	M	15.0	14.9	28.9	24.7	
	AM	(14.8)	(15.2)	(28.0)	(26.1)	
	M	14.9		27.3		
	AM	(16.3)		(27.1)		

The analysis of question five detected a number of subgroup differences existing in terms of the science related cognitive skills attained. Table 4.23 summarizes the total score differences that exist among the subgroups of sex, race and type of school. As can be seen, the greatest differences exist between races and between types of school. Sex differences were practically nonexistent.

Chapter Five

Discussion and Implications of the Findings

One of the objectives of this study was to explore the science related cognitive attainment of a diverse population of students experiencing varying degrees of individualized science instruction. 903 fifth grade students from four open space school and three conventionally constructed schools participated in the study. Since vast differences in instructional style exist between teachers, the challenge was to first develop a method for differentiating the degree of individualized instruction among a group of teachers and secondly, to determine if the detected differences in instructional practices were related to significant differences in student outcomes.

The Instructional Practices Questionnaire (IPQ) seems to be an effective classification device that can be used to identify teachers practicing a high degree of individualization. With a reliability range of .74 to .79 and a set of reasonably uniform factor loadings, the instrument survived a pre-study field test on 298 Reading teachers and 270 Mathematics teachers. The IPQ was then applied to a population of 17 elementary teachers of science and the subsequent scores utilized to classify their classrooms on the basis of the degree of individualized instruction.

In contrasting the science related cognitive skill attainment of students, as measured by the Bristol test, this study identified achievement differences favoring high individualized classrooms. These differences were not only detected on the total Bristol but likewise on four parts of the Bristol, i.e., Properties, Structures, Processes and Explanations. Nonsignificant differences occurred on the fifth part, Interpretations. Teachers classified as high individualized reported higher frequencies of student use of equipment and other science materials. These same teachers reported that students more frequently conduct their own experiments and record observations from these investigations. It seems that the typical teacher response suggested greater involvement was taking place in the high individualized classes. (See Table 5.1).

Discussion of the Research Questions

Question 1. Are there significant differences in the level of science cognitive attainment of children from high individualized science classes in contrast to children from low individualized classes?

Teachers scoring in the upper one-third on the IPQ were classified as high individualized. This scoring was based on summing eleven key items which had been developed on the following individualized instruction criteria: 1) the variety of content available; 2) the amount of content required; 3) the rates of learning expected; 4) the sequence of the content provided; and 5) the variety of methods or activities used. Students experiencing high individualized classrooms classified by these criteria had total Bristol mean scores of 27.7 while low individualized students scored 24.3 on the Bristol. These raw score mean values, favoring the high individualized classrooms, were significantly different ($p < .001$) even when parents' educational level and unique teacher differences were controlled in the analysis. Assuming similar cognitive levels at the start of the study, the results seem to support the contention that higher levels of science related cognitive skills are associated with a higher degree of individualized instruction situation.

Table 5.1

Mean Scores for Various Subgroups of Teachers

on IPQ Science Items[1]

IPQ Item #	Item Statement	High Individualized (N=7)	Medium Individualized (N=4)	Low Individualized (N=6)
25	Students use a variety of books in their science instruction.	4.0	4.8	4.2
26	Reading & writing about different science topics is the chief mode of instruction.	2.7	2.8	3.0
27	Pupils record observations & data from their own experiences.	4.0	3.5	3.3
28	Commercially prepared science kits such as SCIS or ESS are used in addition to science textbooks.	3.2	3.5	2.5
29	Students use equipment and other science materials as a regular part of their science program.	4.7	4.0	3.0
30	Students conduct their own experiments.	4.1	3.3	3.3

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[1] Mean scores may be interpreted by referring to the following IPQ scale:

5 - Very frequently occurs
4 - Often occurs
3 - Sometimes occurs
2 - Rarely occurs
1 - Never occurs

The Bristol subtest that had the most differences associated with the degree of individualization was Part I, Properties. As indicated earlier, this part of the test deals with properties of materials and situations. The Interpretive Manual produced by Thomas Nelson and Sons, Ltd. (1969) states "clearly the success of a child on this section is dependent upon the quality of the direct experience available to him, the vocabulary he has at his disposal, and the concepts he has developed (p. 24)." Perhaps more than just a simple association is operating between the amount of hands-on experiences being acquired by children in high individualized classrooms and the significantly higher scores on Properties.

Students from high individualized classes also scored significantly higher on other parts of the Bristol. The second part, Structures, engages the student in making practical judgments about part-whole relationships. Situations are posed that draw upon the student's ability to resolve problems involving teetering structures and the interaction of parts in pulley systems. Part three, Processes, requires the student to demonstrate his understanding of life cycles, balances and momentum problems.

Taken at face value, Parts I, II, and III theoretically should be able to detect differences in the benefits of the manipulative experiences of children. This study seems to bear out this contention since students performed best on these tests when they came from high individualized science situations--situations in which they had been able to conduct their own experiments. Students experiencing more passive, teacher-directed programs did less well when asked to reason through natural interactions and processes presented in these parts of the Bristol.

The other Bristol subtest that had major differences between high and low individualized classrooms was Part IV, Explanations. This part of the

Bristol is concerned with Piagetian conservation; classification and scientific reasoning. The Bristol Interpretive Manual (1969, p. 24-25) suggest its main theme is "ways of accounting for experience." As with the other subtests, this subtest's results favor high individualized classrooms. Perhaps with youngsters in high individualized classrooms conducting their own science activities, greater practice and experience is gained in dealing with concrete problems. As pupils work with materials, plan and perform experiments, much reasoning is required to synthesize their experiences in meaningful ways. It appears that pupils who do have more frequent experiences in working on and thinking through their own problems in science are more likely to perform well on Part IV, Explanations.

Part V of the Bristol, Interpretations, produced the only non-significant F-ratio between high and low individualized classrooms. This subtest of the Bristol is regarded by the test makers to be the most difficult in terms of the level of abstraction. It deals chiefly with abilities to make inferences from diagrams or symbolically presented data. Even though the high individualized group performed better on this subtest, the differences were not significant. A hypothesis is perhaps in order to account for these slight differences between the high-low groups. It should be noted that both groups achieved the highest proportion of correct responses on this part of the Bristol. This might be explained by inspecting the content of the items. Since a major skill utilized in Interpretations is one that is frequently included and reinforced by mathematics and social studies instruction, both groups should have performed well on this subtest in contrast to the other parts. Furthermore, since interpretations do not necessarily depend on numerous manipulative activities, the experiential advantage held by the high individualized group seems to be less important to performance on this subtest.

Question 2. Are there significant differences in the science related cognitive skills attainment of children experiencing only high individualized programs in open space vs. children experiencing only high individualized programs in conventional schools?

Significant differences were detected on every subtest of the Bristol favoring open space schools. Even though the number of open space students outnumbered conventional students 247-74 in this particular analysis, the results suggest that science related cognitive skills are being developed to a much greater degree in open space schools.

A number of explanations why high individualized open space students perform better on cognitive tests are hypothesized later in this chapter under research question five. In addition to these comments, the investigator's informal visitations to the schools might also yield insights that could account for cognitive differences between schools. All of the open space schools had been constructed and stocked with science materials in the last five years; the conventional school, in which the high individualized classes were being taught, was at least thirteen years old. There was no evidence that the conventional school used or even stocked innovative science kits such as SCIS, ESS, etc. These materials were observed in the open space schools. The general facilities of the open space schools offered the potential for more laboratory-type experiences whereas no labs were available to the conventional school. It was observed that projects prepared for a recent science fair were still set up in the hallway of the conventional school. These displays had a model-building orientation in contrast to the problem solving orientation of projects conducted by students of four open space teachers. Although these observations were too casual to be of great use in this study, the observed differences may have directly or indirectly affected students' development of science related cognitive skills during the course of the year.

Question 3. What is the correlation between the degree of individualized instruction and teachers' open classroom philosophy?

The result of a slight negative correlation between the IPQ and the IATL was not expected. Theoretically, individualized instruction is the most important process in the open classroom. Open classroom operations can utilize multiage grouping procedures, nongradedness, differentiated staffing and team teaching. But open classrooms can also operate without these forms of organization. The critical instructional practice in the open classroom is individualized instruction. Day after day of teacher led discussion is an unacceptable practice according to open education theorists. Hence the correlation, $r = -.15$, between the IATL and the IPQ was surprising. High open classroom ideals as measured by the IATL were expected to be accompanied by high scores on the IPQ.

Assuming that the two instruments are measuring what they purport to measure, at least two explanations for the low correlation are possible. First, it is conceivable that a teacher could believe strongly in the theory of the open classroom, yet not be individualizing her science instruction. Brown (1968), in his book, The Experimental Mind in Education, explores this apparent discrepancy between beliefs systems and classroom practice. His research studies essentially support the findings of the present study. He concludes that teachers' philosophic beliefs generally have a low correlation with their classroom practice.

The second possible explanation is that the low correlation may actually be spurious due to the small sample of teachers. Another sample of the same size might produce high correlations between the IPQ and the IATL. Thus, the results of this research question and the next research question should be taken cautiously since the analysis was conducted on a very small sample of seventeen teachers. Relationships between variables of interest tend to be very unstable when sample sizes are so low. Thus, inferences for Questions 3 and 4 are tenuous at best.

Question 4. What relationships exist between teachers' open classroom philosophy and their respective class distribution of cognitive scores?

The result of a multiple regression analysis of the variables associated with this question was nonsignificant. Test results from each teacher's classes were entered as predictors in the regression model but none of the predictors made any significant contribution to predicting a teacher's IATL score. Again, the small number of subjects presents real limitations on the inferences that can be made from such findings. But based on the data presented in this study, it seems that only slight relationships exist between students' performance on a test of cognitive skills and teachers' open classroom beliefs. Hence, it appears, as in the previous research question, that a teacher's theoretical model of an open classroom is hardly affected by the current situation in which that teacher is working and vice versa. More specifically, the distribution characteristics of a teacher's class only slightly influence her responses to statements about teaching and learning in the open classroom.

Question 5. Are there significant differences in the cognitive attainment of children within various subgroups experiencing either open space or conventional school instruction?

The interaction of type of school and race is depicted in Chart 5.1. Clearly, performance on the composite Bristol depends on race and type of school. The rankings of the eight groups based on their total mean scores also reflect these differences. The rankings of the eight groups based upon Bristol total attainment scores were:

Group	Mean
White open space girls (N = 225)	28.9
White open space boys (N = 212)	28.8
White conventional girls (N = 139)	24.9
White conventional boys (N = 134)	24.4
Black conventional boys (N = 22)	16.6
Black open space girls (N = 24)	15.4
Black open space boys (N = 32)	14.8
Black conventional girls (N = 29)	13.7

The finding in the present study that blacks do significantly poorer on all parts of the Bristol raises additional questions for further study. The fact that white students in open space schools had mean scores almost twice the level of blacks in either conventional or open space schools raises some additional questions for consideration. For instance, why are Bristol mean differences among whites greater between conventional and open space schools than among blacks between the two types of schools? Since blacks from conventional schools perform somewhat better[1] (nonsignificantly) on three of the five subtests, are there aspects of conventionally constructed schools that better accommodate black cultural learning styles? Or could it be that the school is essentially making no difference in black performance on the Bristol; poor performance may instead be reflecting poor educational experiences in the home environment

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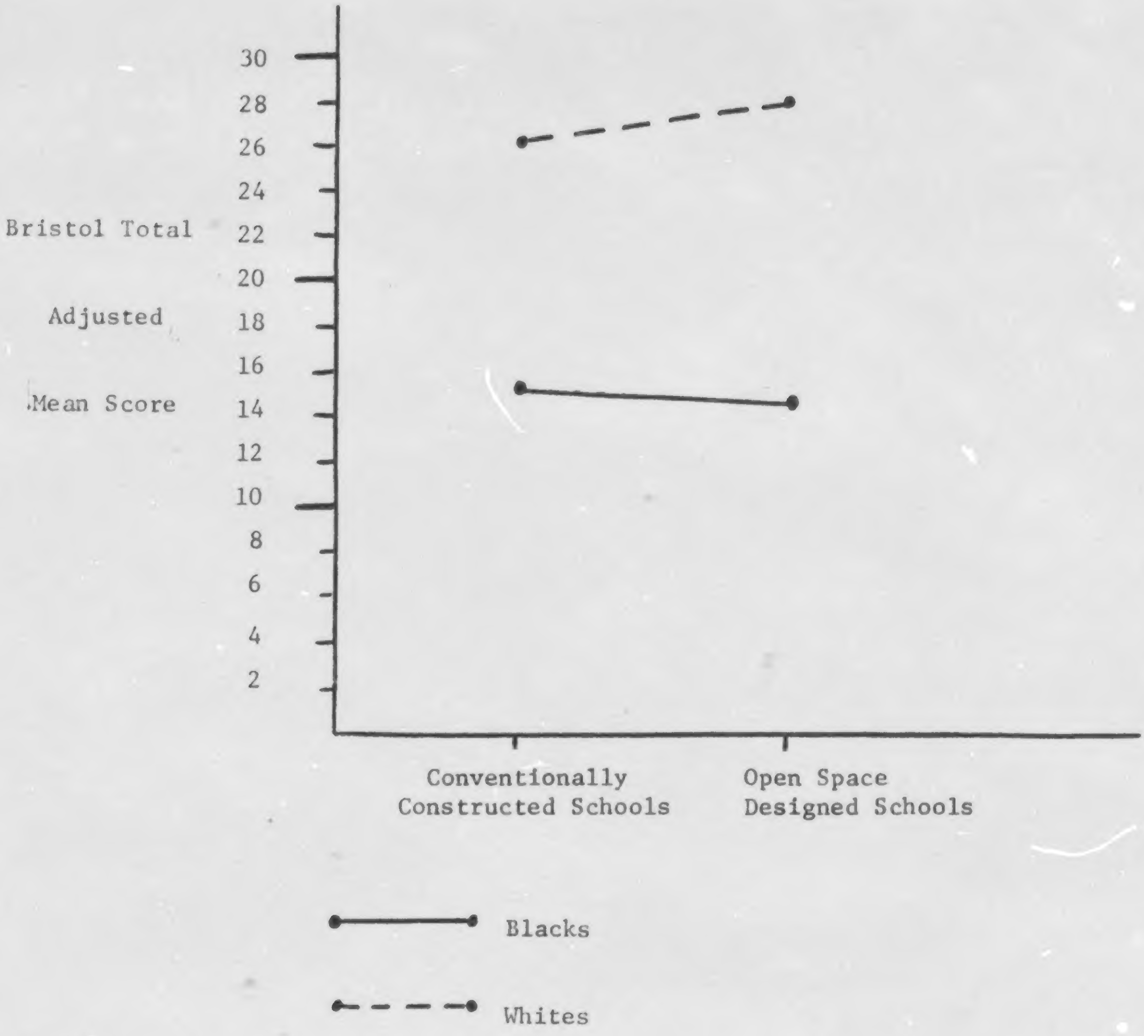
[1] The low scores by blacks in open space schools may be related to these students recently being placed in these schools as part of recent desegregation procedures. Blacks new to open space schools may still be adjusting to the different environment.

CHART 5.1

INTERACTION OF RACE AND SCHOOL

WITH BRISTOL ADJUSTED MEAN SCORES



over a number of years. Poor performance by blacks on cognitive ability measures is well documented in the literature (Coleman, 1966; Jenson, 1969) and in recent years has been the center of debate (see Harvard Educational Review, 1969 and 1973). The present study was not concerned with exploring performance differences due to innate abilities or cultural deprivation, it was only concerned with detecting Bristol differences attributable to race, sex and type of school.

In testing the Bristol differences between sexes on all parts of the Bristol, the results proved nonsignificant. However, an overall test on the composite significantly favored females when parents' educational level was statistically controlled. Still, the mean score differences were only slight in the total group with females scoring 25.8 while males scored 25.6. These differences appear too slight to inflate their importance.

Contrasting the science related cognitive skill development in different types of schools, the results of this study indicate that students in open space schools perform significantly higher than students from conventional schools. Not only is this the case with the composite Bristol score, but also with each of the Bristol subtests. Earlier in this dissertation it was reported that a major rationale for open space school construction was to encourage cooperative teaching, i.e., teaming teachers together to maximize their strengths and minimize their weaknesses. Since high individualized teachers in open space schools reported more frequent cooperative teaching patterns, this would suggest a possible relationship of this variable to the level of science related cognitive skills attained. Even though tentative, this inference may suggest that elementary teachers who are comfortable in teaching science have an important niche in open space schools...the payoff being higher science related cognitive skill development in children.

There are other attributes of high individualized open space settings that should effect cognitive growth besides cooperative teaching. For instance, student time alloted to science, the quality of materials available, or the freedom of children to explore the environment within the parameters planned by the teacher. These are all complex dimensions of the open space setting that need to be more clearly defined and investigated than was possible in the present study.

Implications of the Study

Previously in this chapter only very limited interpretations were provided based upon the research findings. The intent of the following section is to reflect upon the results of this study and speculate about extrinsic relationships that might be influencing these results. Hopefully, the reader will be presented with additional insights that will place the inferences in their proper perspective. The implications of this study will also be presented in terms of present attempts to individualize science instruction. Finally, relationships of individualized instruction to current issues in open education will be presented.

Before presenting the implications of the present study however, the reader is advised to take the reported results cautiously. The finding that open space students perform better on science related cognitive skills should be regarded as a tentative finding. It should not be used as the sole argument for launching new building programs. More research is required that should involve more schools than was possible in the present study. A much more comprehensive longitudinal study is desirable that would take into account initial cognitive differences. Many experienced teachers will testify that the open space designed school is not a panacea but only a beginning, pursuant to making building designs more responsive to the changing needs ot teachers and students.

Nonetheless, the finding that high individualized settings had higher mean scores than settings classified as low individualized is encouraging. This finding should add reassurance to educators who believe that individualized instruction is more desirable than traditional instruction. Since individualized instruction can occur in either open space or conventionally constructed schools, perhaps a conservative recommendation at this time would be to suggest that schools step up their efforts to individualize instruction, but at the same time, take a long, hard look at the payoffs that can be clearly attributable to the type of school housing the instructional approach. Enough examples of different types of schools exist presently to assess which situation holds the greatest educational promise for different children. The "stakes" are too high for us to ignore the importance of such research.

Certainly one of the factors that hinders wide scale individualization of science instruction is the absence of adequate science materials to effectively aid the teacher. A number of different 'innovative' programs are available but most of these are generally too dependent on the teacher or lack sufficient alternatives. Without sufficient packaged materials to draw upon,elementary teachers will be reluctant to even try to individualize their science programs in an open classroom format. Until more individualized materials in a modular format are developed, and until teachers are retrained, the gap between open classroom theory and practice will remain great.

Even if individualized materials were sufficiently available, two major problems would prevail: 1) elementary science, by necessity, 'plays second string' to other academic areas; and 2) elementary teachers do not have adequate training in science to feel comfortable in structuring a science learning environment. When one has limited expertise in science, the tendency for elementary teachers is to put limits on students' explorations.

For the aforementioned reasons one could continue to find low correlations between the IPQ and IATL. Furthermore, further research needs to be done on validating the IATL; it may in fact be measuring more radical school reform views than simply ideas about open classrooms.

Just what are the individualized instruction practices that should be found in open science classrooms? In other words, what does it mean a teacher has to do in order to maximize individualized science instruction? 1) It means creating a stimulating environment by utilizing science kits or other real world materials and supplementing it with learning materials that foster self-correction; 2) it means frequent individual contact and diagnosis of individual needs; 3) it means differentiating assignments or prescriptions based on individual need; 4) it means providing a variety of content topics for study; 5) it means varying the amount of content to be learned between individuals; 6) it means allowing individuals to work and learn at different rates; 7) it means providing variety in the sequence of the content topics; 8) it means utilizing a variety of instructional methods with different students and permitting a variety of activities to occur simultaneously; 9) it means varying the degree of individual choice of activities among students; 10) it means varying the testing or assessment practices; and 11) it means maintaining teacher records of student progress that reflect the previous ten practices.

Earlier in this study, reference was made to statements by radical school reformers. Such statements are examples of thoughts that are contributing to the revolutionary tone underlying much of the critics' writings.

In many ways Silberman (1970) has come to the same conclusions as the radical school reformers. In a very comprehensive study of our nation's schools. Silberman describes schools as "those killers of the dream...what grim, joyless places most American schools are, how oppressive and petty are the rules by which they are governed, how intellectually sterile and esthetically barren the atmosphere, what an appalling lack of civility obtains on the part of teachers and principals, what contempt they unconsciously display for children as children." He continues: "It is not possible to spend any prolonged period visiting public school classrooms without being appalled by the mutilation everywhere--mutilation of spontaneity, of joy in learning, of pleasure in creating, of sense of self. (1970, p. 10)."

In many ways the Free School movement and the open education movement are reactions to the negative aspects of traditional instruction. Still, at some point in time we must begin finding out whether what is being done in either open classrooms, Free Schools or even traditional classrooms is really in the best interest of children. For instance, with the increased emphasis on affective development in a less structured environment, will students come away from schools ill-prepared academically, and full of illusions of the world? Again, it would seem important that basic research be conducted to identify what kinds of learning environments are really best for the majority of our youth.

Thus, it appears that some soul searching on our part is definitely in order. It may be that as a result of this soul searching we will conclude that the most important things we can provide in our schools are alternatives...alternatives for student choice of classrooms, teachers and program. For it is only through opening up the schools that we can provide different environments to accomodate the various learning styles of children, i.e., structured or teacher- centered for those who function best there, free and open for those who can function there. It may be that instead of an era of revolution we may be entering an era of crisis and conflict in educational philosophy. What should the goals of our schools be? What roles should students and teachers play in these schools? What school policies need to be changed so that the schools we want can evolve? These are crucial questions--ones that can split a faculty or divide a community. But above all the disagreements that are bound to occur, we need to maintain the dialog and respect the rights of all to determine their own style of education.

That students who experience high individualized science program develop higher levels of science cognitive attainment, supports the beliefs of many science educators. For years science educators have claimed that student-centered, inquiry oriented classrooms are more desirable than teacher-centered, reading oriented science classes. Fewer educators have been willing to commit themselves to individualized modes of instruction, even though many will support it in theory. This study lends support to those who believe that students need to be active participants in the exploration of scientific problems. The processes of science seem to be best understood when students practice them in high individualized classrooms.

If science related cognitive skills are to be included as goals of schools, then appropriate modes of instruction that foster such skills need to be included in the schools' programs. The results of this study suggest that higher levels of cognitive growth seem to be related to the degree of individualized classroom structure and the opportunities for students to perform their own investigations.

Other subject matter areas of the school's curriculum can benefit by pupils developing science related cognitive skills. The ability to think logically, and to reason is applicable to most academic disciplines. Being able to detect similarities and differences, to explain causation of events, and to interpret and communicate one's experiences are vital skills of a truly educated person. The results of this study suggest that when experimental-based science programs are individualized, these cognitive abilities are developed to a significant degree.

Summary

The completed study contrasted the science related cognitive skill attainment of children experiencing high and low individualized science programs. In addition, skill development was compared between open space schools and conventional schools. A total of 903 fifth grade pupils from seven schools were given a short revision of the Bristol Study Skills Test and a Student Questionnaire. Concurrently, teachers were given two instruments that would report their instructional practices and open classroom beliefs.

The following data collection instruments were used:

(1) Instructional Practices Questionnaire (IPQ), developed by the investigator and local school research staff; measures the degree of individualized instruction being practiced by a given teacher.

(2) Ideas About Teaching and Learning (IATL), developed by the investigator; measures teachers' philosophy or beliefs about the open classroom and practices that ought to occur there.

(3) Student Questionnaire (SQ), developed by the investigator to measure students' view of how they generally go about their science studies.

(4) Bristol Study Skills (The Bristol), a short version of a commercial standardized instrument adapted by the investigator; measures students' science related cognitive skills; the test yields five subtest scores and a total score.

The analysis of the results indicated that students experiencing high individualized science programs perform significantly better on the first four parts of the Bristol. The multivariate analysis of covariance statistically controlled for the effect of parents' educational level and unique classroom effects. Students in open space schools likewise scored significantly higher on science related cognitive skills than students attending conventional schools. Analysis of subgroup results (i.e., school, sex and race) were also reported. Relationships between teachers' open classroom beliefs and their instructional practices were negligible. A similar finding was reported between student cognitive performance and teachers' open classroom beliefs.

The study raises a number of questions for future exploration. Relationships between the findings and the current open classroom movement are provided with special emphases on problems associated with individualizing science instruction.

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APPENDIX A.

Instructional Practices Questionnaire (IPQ)

INSTRUCTIONAL PRACTICES QUESTIONNAIRE

________________________ Teacher Name

________________________ School

I. General description of teaching situation:

1. In which type of setting do you teach science?

Standard classroom (four solid walls) ________

Portable classroom ________

Pod or suite (two or more rooms with sliding walls between) ________

Flexible or open space (two or more rooms with no walls between, solid or sliding) ________

Other(Specify ________________________)

2. How many university courses have you taken in the teaching of science? Specify the number of courses (not credit hours) here: ________

3. How many years of science teaching experience do you have?

0 - 2 years ________

3 - 6 years ________

7 or more ________

4. How many years have you taught at your present school?

0 - 2 years ________

3 - 6 years ________

7 or more ________

II. Instructional methods used in your formal science program:

Please answer each of the following items according to the frequency a stated activity occurs in your teaching situation. If you do not teach formal (directed) science do not complete this section.

For each item, please circle the number next to the statement that best describes your situation. Use the following scale:

5 - Very frequently occurs
4 - Often occurs
3 - Sometimes occurs
2 - Rarely occurs
1 - Never occurs

1. Pupils within a class are grouped homogeneously on achievement or performance in this subject. 1 2 3 4 5

2. Teaching is directed to an entire class in this subject. 1 2 3 4 5

3. Instruction is directed to temporarily formed skills groups in this subject. 1 2 3 4 5

4. Students receive skills instruction through individual pupil-teacher conferences. 1 2 3 4 5

5. Pupil's progress proceeds at the pace of the group to which he is assigned. 1 2 3 4 5

6. Pupils are given individualized assignments only after they have completed the required group assignments. 1 2 3 4 5

7. Pupil's progress is paced by individually prepared prescriptions or contracts. 1 2 3 4 5

8. Pupils help plan assignments with teachers on a one-to-one basis. 1 2 3 4 5

9. Pupils maintain a record of their own progress. 1 2 3 4 5

10. Instruction is sequenced in this subject primarily on teacher judgment. 1 2 3 4 5

11. Instruction is sequenced in this subject according to a teachers' manual. 1 2 3 4 5

12. A variety of learning activities occur at the same time in this subject. 1 2 3 4 5

13. Pupils change skill groups as their performance changes. 1 2 3 4 5

14. Pupils are allowed to initiate studies in curriculum topics from a higher grade level whenever they are ready. 1 2 3 4 5

15. I plan my students' instruction with other teachers. 1 2 3 4 5

5 - Very frequently occurs
4 - Often occurs
3 - Sometimes occurs
2 - Rarely occurs
1 - Never occurs

16. My students have individual conferences with me at least once a week. 1 2 3 4 5

17. The same tests and other forms of evaluation are given to an entire class of pupils at the same time. 1 2 3 4 5

18. Pupils initiate changes in topics of study in this subject. 1 2 3 4 5

19. Diagnostic tests are given to pupils on an individual basis when pupils are ready to make changes in their programs of study. 1 2 3 4 5

20. Instructional groups in this subject are cross-graded (i.e., pupils from two or more grades are in the same group). 1 2 3 4 5

21. All students are expected to learn the same amount of material or the same number of skills. 1 2 3 4 5

22. Pupils are grouped according to their interests in this subject. 1 2 3 4 5

23. Instruction is uniquely sequenced for each student in this subject area. 1 2 3 4 5

24. For instruction in this subject groups are heterogeneous. 1 2 3 4 5

25. Students use a variety of books in their science instruction. 1 2 3 4 5

26. Reading and writing about different science topics is the chief mode of instruction. 1 2 3 4 5

27. Pupils record observations and data from their own experiences. 1 2 3 4 5

28. Commercially prepared science kits such a SCIS or ESS are used in addition to science textbooks. 1 2 3 4 5

29. Students use equipment and other science materials as a regular part of their science program. 1 2 3 4 5

30. Students conduct their own experiments. 1 2 3 4 5

APPENDIX B.

Ideas About Teaching and Learning (IATL)

IDEAS ABOUT TEACHING AND LEARNING

Please complete the following information:

Name:____

School:______________________________________

Total years teaching experience (including current year)____________________

Number of years in present situation (including current year)________________

Instructions:

Following is a list of statements about teaching and learning. We all think differently about such matters, and this scale is an attempt to let you express your beliefs and opinions. Respond to each of the items using the following scale:

1. Strongly agree
2. Agree
3. Tend to agree
4. Undecided
5. Tend to disagree
6. Disagree
7. Strongly disagree

For example, if you strongly agree with a statement, you would circle the 1 from the list of numbers next to the item. If you strongly disagree, you would circle 7.

Since this is a survey of opinions, it is desired that you indicate *your own personal opinions* regarding these questions, regardless of whether you think other people might agree or disagree with you. There are no "right" or "wrong" answers to these statements. This is a study of *personal opinions,* and of *personal opinions only.* Please fill these forms our independently.

Rating scale:
1. Strongly agree
2. Agree
3. Tend to agree
4. Undecided
5. Tend to disagree
6. Disagree
7. Strongly disagree

---

1. Learning how to learn is more important than learning facts these days. 1 2 3 4 5 6 7

2. When it comes to learning during early childhood, work and play are complementary. 1 2 3 4 5 6 7

3. The teacher should do less direct teaching and be more of an advisor, consultant and catalyst for learning. 1 2 3 4 5 6 7

4. Older children should be utilized more by the schools to help younger children in the ways of learning, such as with reading skills. 1 2 3 4 5 6 7

5. Teachers should be informed of the IQ scores and other ability scores of all students before a new school year begins. 1 2 3 4 5 6 7

6. There should be set time blocks during the day for instruction in reading, math, etc. 1 2 3 4 5 6 7

7. In judging a child's writing, the primary emphasis should be placed upon accuracy, neatness, good spelling and grammar. 1 2 3 4 5 6 7

8. Obedience and respect for authority are the most important virtues schools should emphasize. 1 2 3 4 5 6 7

9. It is important that the physical environment of the classroom be structured, such as by dividing the room into learning centers. 1 2 3 4 5 6 7

10. Classroom chaos would most likely occur if children were allowed complete freedom to choose their own activities. 1 2 3 4 5 6 7

11. A school should know where any given child is every moment of the day. 1 2 3 4 5 6 7

12. Students should not be allowed to use books or notes when taking tests. 1 2 3 4 5 6 7

13. The classroom should not be a place where children play or wander. 1 2 3 4 5 6 7

14. A child's experience in school should not include experiences with failure. 1 2 3 4 5 6 7

15. Large group drill and practice should be abandoned as the primary approach to teaching. 1 2 3 4 5 6 7

Rating scale:
1. Strongly agree
2. Agree
3. Tend to agree
4. Undecided
5. Tend to disagree
6. Disagree
7. Strongly disagree

---

16. Students should be given more opportunities to tinker about and manipulate concrete objects. 1 2 3 4 5 6 7

17. Nearly all students can be trusted in most school situations without close supervision. 1 2 3 4 5 6 7

18. It is more socially desirable to keep a child with his own age group, even if he has difficulty doing the work. 1 2 3 4 5 6 7

19. In day-to-day classroom interaction, formal standardized tests are more valid estimates of the individual needs of children than are teacher's intuitive feelings. 1 2 3 4 5 6 7

20. Learning concepts and principles is more important than developing a positive self-concept or interest in learning. 1 2 3 4 5 6 7

21. Presenting content to students in great detail is not required for good teaching to occur. 1 2 3 4 5 6 7

22. There is probably no such thing as unique learning styles of individual children. 1 2 3 4 5 6 7

23. It is not particularly important for parents to know the philosophy and goals of a school. 1 2 3 4 5 6 7

24. Failure should not be counted against a child. 1 2 3 4 5 6 7

25. Most of the schools in America have become so strict and inflexible today that they are destroying children's spontaneity, curiosity and love of learning. 1 2 3 4 5 6 7

26. The classroom is no place for conflict, disagreement or argument. 1 2 3 4 5 6 7

27. A child must learn that sometimes his freedom must be limited so as not to interfere with the freedoms and rights of others. 1 2 3 4 5 6 7

28. Good interpersonal relationships among teachers may be the most critical aspects of successful team teaching in an open space learning environment. 1 2 3 4 5 6 7

29. The policy of schools should be free enough so that if a child did not want to work on a given day, he would not be pressured to do so. 1 2 3 4 5 6 7

30. In addition to official records, students should keep their own achievement records and accounts of what they are doing. 1 2 3 4 5 6 7

Rating scale:
1. Strongly agree
2. Agree
3. Tend to agree
4. Undecided
5. Tend to disagree
6. Disagree
7. Strongly disagree

---

31. In any discipline, there exists some indispensable body of knowledge that every educated person should know. 1 2 3 4 5 6 7

32. Many different concurrent activities in a classroom actually hinder the productive learning behavior in children. 1 2 3 4 5 6 7

33. Schools should allow the child to be free to experience the world around him in his own way. 1 2 3 4 5 6 7

34. For learning to be more lasting, parents need to reinforce those behaviors the schools are teaching. 1 2 3 4 5 6 7

35. Daily compulsory school attendance is vital for every child, whether he wants to be in school or not. 1 2 3 4 5 6 7

36. Schools should teach students the techniques of taking tests. 1 2 3 4 5 6 7

37. Teachers should be less concerned about students covering material in a given curriculum. 1 2 3 4 5 6 7

38. When more than thirty students are grouped together in the same physical area, the amount of learning that can take place decreases. 1 2 3 4 5 6 7

39. Teachers should allow children much more freedom to choose their own learning activities during the day. 1 2 3 4 5 6 7

40. Daily time schedules are necessary in school operations. 1 2 3 4 5 6 7

41. Grades are the most effective ways to motivate students. 1 2 3 4 5 6 7

42. Teachers should be more concerned about students defining and pursuing their own goals. 1 2 3 4 5 6 7

43. Most schools today do not put the emphasis upon the child learning, but rather on the teacher teaching. 1 2 3 4 5 6 7

44. Pupils can behave themselves without constant supervision. 1 2 3 4 5 6 7

45. As instructional leaders of schools, principals should spend much more time in the classroom. 1 2 3 4 5 6 7

46. In learning, failure is as important as success. 1 2 3 4 5 6 7

47. Getting good grades should be the most important goal for the majority of our youth while they are in school. 1 2 3 4 5 6 7

Rating scale:
1. Strongly agree
2. Agree
3. Tend to agree
4. Undecided
5. Tend to disagree
6. Disagree
7. Strongly disagree

---

48. In most cases, the exertion of pressure to learn on children will not adversely affect their attitudes toward learning. 1 2 3 4 5 6 7

49. Parents should be kept out of the administration of the school. 1 2 3 4 5 6 7

50. Most children learn because they are afraid of failing, or the consequences of failing. 1 2 3 4 5 6 7

APPENDIX C.

Bristol Study Skills (The Bristol)

BRISTOL ACHIEVEMENT TESTS

Study Skills Form P

Alan Brimer
Margaret Fidler
Wynne Harlen
John Taylor

NAME ______________________ ______________________
last first

BOY ○ GIRL ○ TODAY'S DATE ______ ______ ______
day month year

SCHOOL ____

DATE OF BIRTH ______ ______ ______ AGE ______ ______
day month year years months

Sub-test	Properties	Structures	Processes	Explanations	Interpretations	Total Raw Score
Raw Score						

HOW TO WORK THIS TEST

When you are told to begin, turn over the page and read what you have to do, then start working.

When you have finished one page, turn over and go on with the next. Do not wait to be told.

The test is in parts and after some time you will be told to leave one part and go on with the next.

Often the questions are asked in such a way that you have to complete a sentence by making a cross next to the right answer like this ⊗ or by writing a letter or a word or by underlining. When you are asked to answer in other ways you will be told what to do.

Work fast. Write if you can, rather than print.

If you make a mistake, cross it out neatly and make your correct answer.

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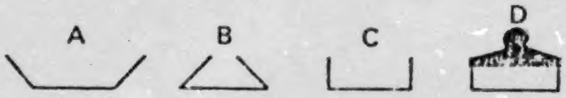
PART 1.



○ 1. Water is lost when it is left open to the air. From which of these basins would it be lost:

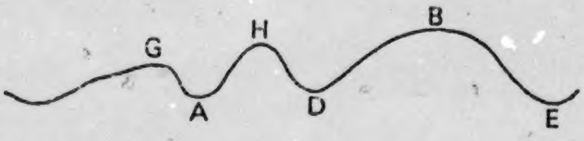
most easily? ....

not at all? ....

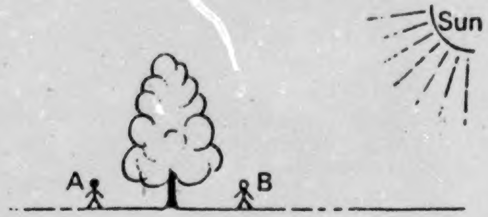
very little? ....

○ 2. Which of these things would a magnet pick up?

- ○ a stalk of a flower
- ○ a drop of water
- ○ a piece of coal
- ○ a sharp iron nail
- ○ a bread crumb



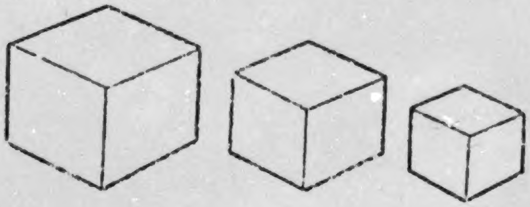
○ 3. The hills are marked ...., ... and .... The valleys are marked ...., ... and ....



○ 4. The man at .... is standing in the shade of the tree.

The man at .... feels hotter than the man at ....

○ 5. These three blocks are the same weight but one is made of lead, one of wood, and the other of stone. Write under each block what it is made of.



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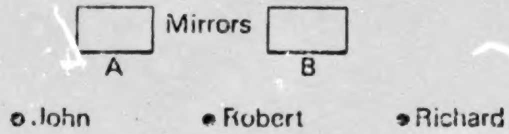
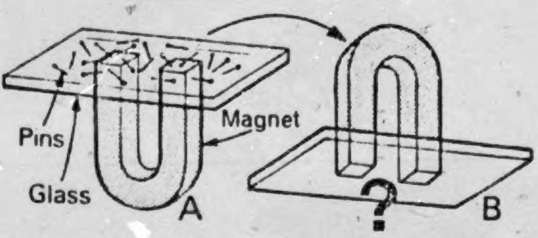


When Robert looks into mirror A he can see John. Who do the others see in the mirrors?

○ 6. When .... looks into mirror .... he sees Richard.

○ 7. When Richard looks into mirror ....

he sees ....



○ 8. In A the pins move about on top of the glass when the magnet is moved about underneath. What will happen in B when the magnet and glass are turned upside down?

- ○ the pins will stay on all over the glass
- ○ the pins will all fall off
- ○ the pins will stay on just under the magnet
- ○ do not know

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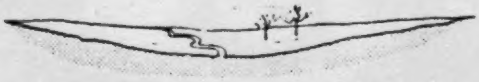
9. Write A under the valley with the most steeply sloping sides, and B under the valley with the most gently sloping sides.

○



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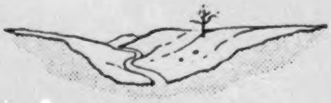

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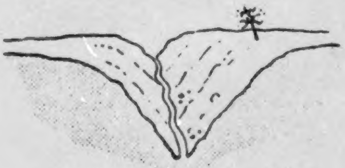


....

10. Underline any of these things that could grow if they were put into soil and looked after:

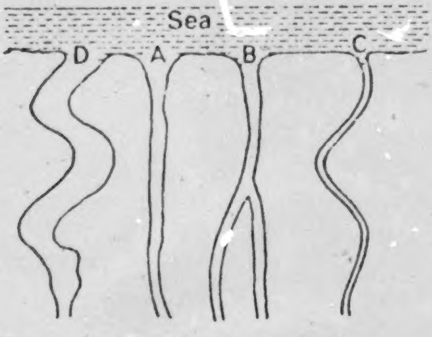
○

a button
a cornflake
a grain of rice
a pin
a pea

11. What will a seed from a sycamore tree become when it is blown into a flower bed and starts to grow? Underline the answer.

○

a bigger seed
a flower
a sycamore tree
a heap of soil
a baby apple tree



12. The narrowest river is marked ....

○

The widest river is marked ....

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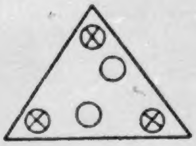
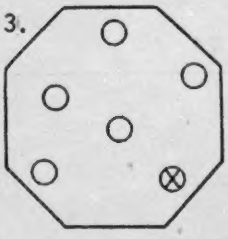
PART 2.

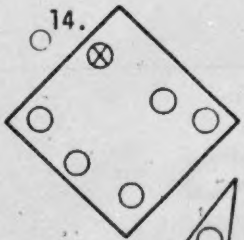
These table tops need three legs each to keep them up. One leg has been put where the cross is. Make crosses in TWO of the other rings where the other legs should go to make the table most steady. The first has been done for you.



13. ○



14. ○



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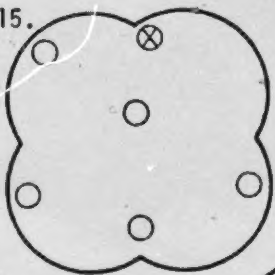
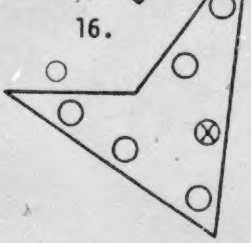
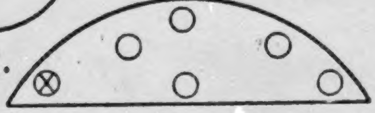


16. ○



17. ○



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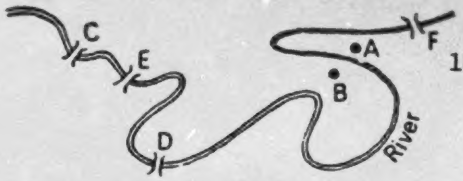
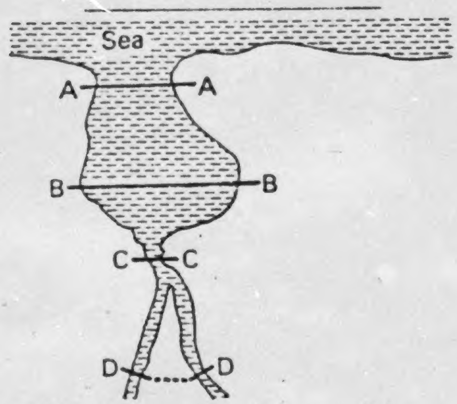
18. The quickest way to walk from A to B
○ would be to cross
the bridge marked ....

The longest way from B to A
is over the bridge marked ....

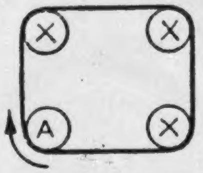




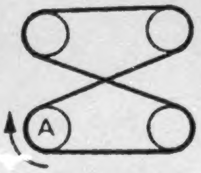
19. The most expensive place to build a
○ bridge over this river is likely to be at
the place marked with the letter ....

20. A bridge built at the place marked
○ .... would require a new road as well
as a bridge.

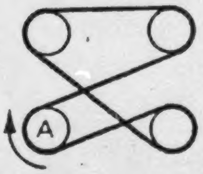
The four wheels have a loop of string tied tightly round them. When wheel A turns, the other wheels turn also. In each diagram put a cross on the wheels that will turn the same way round as A. The first has been done for you.



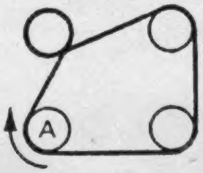
○ 21.



○ 22.



○ 23.



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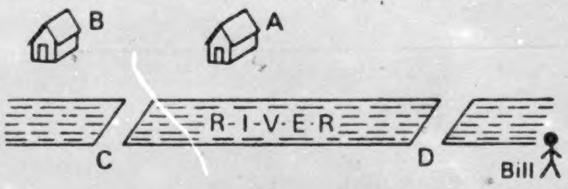
24. The shortest way for Bill to walk to
○ house A is to cross the bridge marked ....



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Go onto Part 3

PART 3.

25. Which of these shows how young frogs are produced?
○
- ○ Parent frog ⟶ Young frog
- ○ Parent frog ⟶ Egg ⟶ Young frog
- ○ Parent frog ⟶ Tadpole ⟶ Egg ⟶ Young frog
- ○ Parent frog ⟶ Egg ⟶ Tadpole ⟶ Young frog

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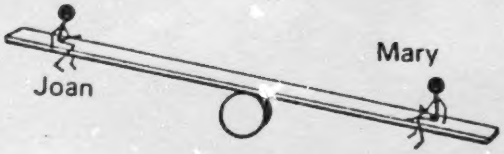
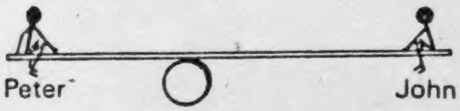


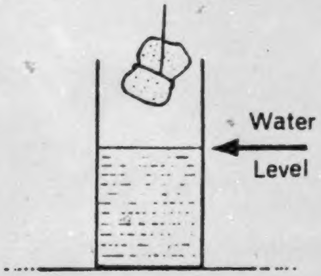
26. Mary is heavier than Joan so the see-saw does not balance when they sit like this. It will balance if Mary moves:
○

○ nearer to the end
○ nearer to the centre
○ it will not balance wherever Mary is
○ cannot tell



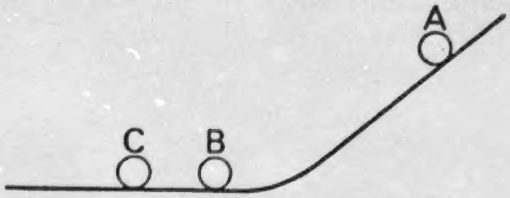
27. If Peter and John balance each other like this, who is heavier?
○

○ John
○ Peter
○ both the same
○ cannot tell



28. When the stone is put into the water, the water level:
○

○ stays the same
○ goes down
○ goes up
○ do not know



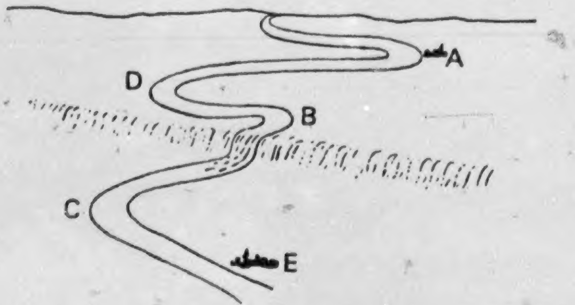
Balls A, B and C are made of wood and are exactly the same. Ball A rolls down the slope and hits B. What happens to the balls?

29.
○

Ball B	Ball C
○ stays still	○ pushes B back
○ hits C	○ stays still
○ pushes A back	○ rolls forward

30. When Spring comes, apple trees start to grow again until the next Winter. Write 1 against the thing that happens first, 2 against the next, and so on.
○

blossom opens................ fruit ripens................
leaf buds burst................ flowers drop off................



31. A man began rowing his boat down the river from Village A towards Village E. But he had to leave the boat and finish the journey
○

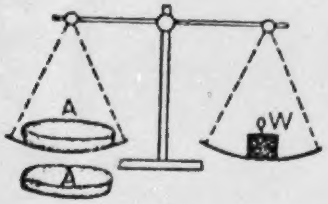
by walking from the spot marked ....
It was dangerous to row further than this because the river was becoming:

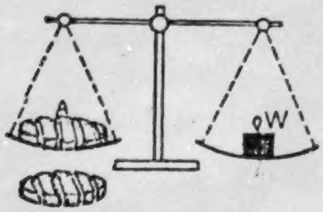
○ too wide
○ too slow
○ too fast
○ too narrow

Go on to Part 4

Page total (Pt. 3) (No. right)	Part 3 total (No. right)

PART 4.

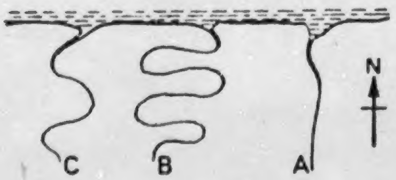




32. ○ A was put on some scales and balanced a weight W. A was then cut into many pieces, which were all put back on the scales. These weighed:

○ more than W ○ the same as W

○ less than W ○ cannot tell



33. ○ The longest river is marked ....

The shortest river is marked ....

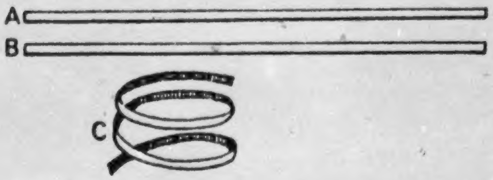
34. ○ Why do clouds sometimes move quickly and sometimes slowly in the sky? It depends on:

○ how sunny the day is

○ how quickly you are walking when you see them

○ how fast the wind is blowing

○ how much air the clouds make to push them



35. ○ A and B are exactly equal strips of silver paper. B is rolled up and made into a spiral C. The length of silver paper in C is:

○ greater than in A ○ the same as in A

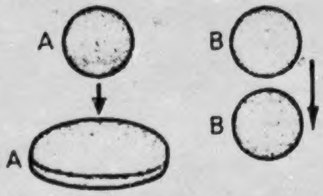
○ less than in A ○ cannot tell

36. ○ The things in Group A are put together because they are the same kind of thing and are different from those in Group B.

Group A	Group B
butterfly	train
frog	radio set
grass	scooter
cat	rain

Which group does each of these belong to? Put A or B after each.

tree.............. river.............. goldfish..............



37. ○ A and B are two identical balls of clay. After A has been squashed flat the amount of clay in it is then:

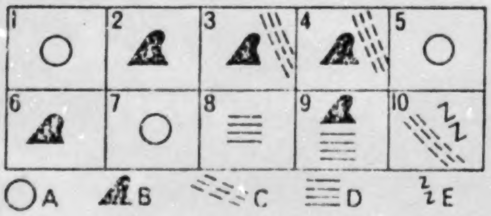
○ more than in B ○ the same as in B

○ less than in B ○ cannot tell

Part 4 total
(No. right)

Go on to Part 5 over the page

PART 5.



38. The symbols used on this weather chart are given below it. If symbol A means sunshine, how many sunny days were there?
○

○ 1 ○ 2 ○ 3 ○ 4

39. If it was raining on the 3rd, 4th and 10th days, which symbol means rain?
○

○ A ○ B ○ C ○ D ○ E

40. There were two windy days. Which symbol means wind?
○

○ A ○ B ○ C ○ D ○ E

	DAMP	DRY
Woodlice	XXXXXX	
Worms	XXXX	
Spiders		XXXXXX
Slugs	XXX	X
Snails	XXXX	XXX
Centipedes	XXX	XXXXX

On a nature walk some children counted the different kinds of animals they found under stones. They looked under stones on dry ground and on damp ground, and kept the counts separately. Afterwards they made a chart and put one X by the name of the animal for every time they found that kind under a stone.

41. Which kind of animal was found most often under dry stones?
○

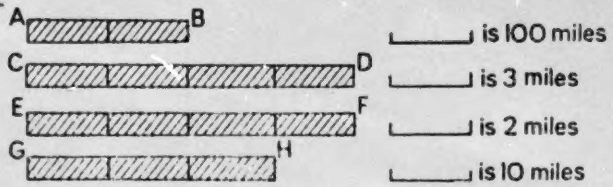
○ woodlouse ○ slug ○ worm
○ spider ○ snail ○ centipede

42. Were fewer different kinds of animal found under damp stones or under dry stones?
○

○ fewer under damp ○ the same under both
○ fewer under dry ○ cannot tell

43. Centipedes were found more often under:
○

○ dry stones ○ both the same
○ damp stones ○ cannot tell



In these drawings, ▨ stands for different distances. Complete the sentences below by writing the letters.

44 It is a shorter distance from G to H than it is
○ from .... to ....

45. It is a shorter distance from .... to ....
○ than it is from C to D.

End of the test.

Part 5 total (No. right)	

Look over your work while the others finish.

APPENDIX D.

Student Questionnaire (SQ)

STUDENT QUESTIONNAIRE

Name:______________________________ Your teacher:__________________________________

A. These questions have no right or wrong answers. Please check the one response which best tells how you study in science.

MULTIPLE CHOICE

1. How often do you work in groups in science?
   _______often

   _______seldom

2. How often do you work by yourself in science?
   _______often

   _______sometimes

   _______seldom

3. How often do you have individual conferences with your teacher?
   _______often

   _______sometimes

   _______seldom

4. How often are the assignments the same for everyone?
   _______often

   _______seldom

5. Do you often help plan what activities you will do?
   _______no

   _______yes

6. Do you often help decide when your assignments will be due?
   _______no

   _______yes

7. How often do all students take the same test in a group at the same time?
   _______often

   _______sometimes

   _______seldom

APPENDIX E.

Parents' Educational Level (PEL)

Coding Scheme

Coding Scheme for Parent Education Level

0 = Unknown (not reported by school)

1 = No formal schooling (specifically reported)

2 = Some grade school (Grade 5 or less)

3 = Finished grade school (6th, 7th or 8th grade)

4 = Some high school

5 = Finished high school

6 = Some college (Nursing school included)

7 = Finished four-year college

8 = Some graduate, professional school

9 = Graduate or professional degree

APPENDIX F.

Three Forms of the Instructional Practices Questionnaire (IPQ)

Note to the Reader:

The first Instructional Practices Questionnaire includes items to be answered by all teachers, whether they teach reading or mathematics. The questionnaire is divided into three parts:

I. General Description of teaching situation.

II. Instructional methods used in the formal reading program.

III. Instructional methods used in the formal mathematics program.

The first twenty-four times in Parts II and III are worded identically. Other items were added to probe methods unique to reading or mathematics. Parts II and III are regarded as two separate versions of the IPQ.

The second IPQ, also provided in Appendix A, was the teacher instrument used in exploring the research questions in this dissertation. The first twenty-four items of Part II are identical to Parts II and III of the previous instrument. Items 25-30 are unique to science.

INSTRUCTIONAL PRACTICES QUESTIONNAIRE

______________________________	___________________________________	____
Name	School	Grade

I. General description of teaching situation.

1. In which type of setting do you teach?

Standard classroom (four solid walls) ____

Portable classroom ____

Pod or suite (two or more rooms with sliding walls between) ____

Flexible or open space (two or more rooms with no walls between, solid or sliding) ____

Other (specify ____________________________)

2. Would you describe your organization for instruction as:

Self-contained ____

Something else ____

3. Are you responsible for teaching formal (directed) reading?

Yes ____

No ____

4. Are you responsible for teaching formal (directed) mathematics?

Yes ____

No ____

5. How many university courses have you taken in the teaching of reading? Specify number of courses (not credit hours) here: ____

6. Has your university training in reading been helpful to you?

Yes ____

No ____

Have had none ____

7. How many university courses have you taken in the teaching of math? Specify number of courses (not credit hours) here: ____

8. Has your university training in math been helpful to you?

Yes ____

No ____

Have had none ____

9. How many Broward County inservice programs in the teaching of reading have you attended? Specify number of programs attended here: ____

10. Has your inservice training in reading been helpful to you?

Yes ____

No ____

Have had none ____

11. How many Broward County inservice programs in the teaching of math have you attended? Specify number of programs attended here: ____

12. Has your inservice training in math been helpful to you?

Yes ____

No ____

Have had none ____

II. Instructional methods used in your formal READING program:

Please answer each of the following items according to the frequency a stated activity occurs in your teaching situation. If you do not teach formal (directed) reading, do not complete this section.

For each item, please circle the number next to the statement that best describes your situation. Use the following scale:

5 - Very frequently occurs
4 - Often occurs
3 - Sometimes occurs
2 - Rarely occurs
1 - Never occurs

1. Pupils within a class are grouped homogeneously on achievement or performance in this subject. 1 2 3 4 5

2. Teaching is directed to an entire class in this subject. 1 2 3 4 5

3. Instruction is directed to temporarily formed skills groups in this subject. 1 2 3 4 5

4. Students receive skills instruction through individual pupil-teacher conferences. 1 2 3 4 5

5 - Very frequently occurs
4 - Often occurs
3 - Sometimes occurs
2 - Rarely occurs
1 - Never occurs

5.	Pupil's progress proceeds at the pace of the group to which he is assigned.	1	2	3	4	5
6.	Pupils are given individualized assignments only after they have completed the required group assignments.	1	2	3	4	5
7.	Pupil's progress is paced by individually prepared prescriptions or contracts.	1	2	3	4	5
8.	Pupils help plan assignments with teachers on a one-to-one basis.	1	2	3	4	5
9.	Pupils maintain a record of their own progress.	1	2	3	4	5
10.	Instruction is sequenced in this subject primarily on teacher judgment.	1	2	3	4	5
11.	Instruction is sequenced in this subject according to a teachers' manual.	1	2	3	4	5
12.	A variety of learning activities occur at the same time in this subject.	1	2	3	4	5
13.	Pupils change skill groups as their performance changes.	1	2	3	4	5
14.	Pupils are allowed to initiate studies in curriculum topics from a higher grade level whenever they are ready.	1	2	3	4	5
15.	I plan my students' instruction with other teachers.	1	2	3	4	5
16.	My students have individual conferences with me at least once a week.	1	2	3	4	5
17.	The same tests and other forms of evaluation are given to an entire class of pupils at the same time.	1	2	3	4	5
18.	Pupils initiate changes in topics of study in this subject.	1	2	3	4	5
19.	Diagnostic tests are given to pupils on an individual basis when pupils are ready to make changes in their programs of study.	1	2	3	4	5
20.	Instructional groups in this subject are cross-graded (i.e., pupils from two or more grades are in the same group).	1	2	3	4	5

5 - Very frequently occurs
4 - Often occurs
3 - Sometimes occurs
2 - Rarely occurs
1 - Never occurs

21. All students are expected to learn the same amount of material or the same number of skills. 1 2 3 4 5

22. Pupils are grouped according to their interests in this subject. 1 2 3 4 5

23. Instruction is uniquely sequenced for each student in this subject area. 1 2 3 4 5

24. For instruction in this subject groups are heterogeneous. 1 2 3 4 5

25. Students use a variety of books and materials in their reading instruction. 1 2 3 4 5

26. Informal reading inventories are used to set up students' programs. 1 2 3 4 5

27. Students read orally in groups. 1 2 3 4 5

28. Students read orally in one-to-one conferences with the teacher. 1 2 3 4 5

29. Students choose the book they will use for formal reading instruction. 1 2 3 4 5

III. Instructional methods used in your formal MATHEMATICS program:

Please answer each of the following items according to the frequency a stated activity occurs in your teaching situation. If you do not teach formal (directed) mathematics, do not complete this section.

For each item, please circle the number next to the statement that best describes your situation. Use the following scale:

5 - Very frequently occurs
4 - Often occurs
3 - Sometimes occurs
2 - Rarely occurs
1 - Never occurs

1. Pupils within a class are grouped homogeneously on achievement or performance in this subject. 1 2 3 4 5

2. Teaching is directed to an entire class in this subject. 1 2 3 4 5

5 - Very frequently occurs
4 - Often occurs
3 - Sometimes occurs
2 - Rarely occurs
1 - Never occurs

3. Instruction is directed to temporarily formed skills groups in this subject. 1 2 3 4 5

4. Students receive skills instruction through individual pupil-teacher conferences. 1 2 3 4 5

5. Pupil's progress proceeds at the pace of the group to which he is assigned. 1 2 3 4 5

6. Pupils are given individualized assignments only after they have completed the required group assignments. 1 2 3 4 5

7. Pupil's progress is paced by individually prepared prescriptions or contracts. 1 2 3 4 5

8. Pupils help plan assignments with teachers on a one-to-one basis. 1 2 3 4 5

9. Pupils maintain a record of their own progress. 1 2 3 4 5

10. Instruction is sequenced in this subject primarily on teacher judgment. 1 2 3 4 5

11. Instruction is sequenced in this subject according to a teachers' manual. 1 2 3 4 5

12. A variety of learning activities occur at the same time in this subject. 1 2 3 4 5

13. Pupils change skill groups as their performance changes. 1 2 3 4 5

14. Pupils are allowed to initiate studies in curriculum topics from a higher grade level whenever they are ready. 1 2 3 4 5

15. I plan my students' instruction with other teachers. 1 2 3 4 5

16. My students have individual conferences with me at least once a week. 1 2 3 4 5

17. The same tests and other forms of evaluation are given to an entire class of pupils at the same time. 1 2 3 4 5

18. Pupils initiate changes in topics of study in this subject. 1 2 3 4 5

5 - Very frequently occurs
4 - Often occurs
3 - Sometimes occurs
2 - Rarely occurs
1 - Never occurs

19. Diagnostic tests are given to pupils on an individual basis when pupils are ready to make changes in their programs of study. 1 2 3 4 5

20. Instructional groups in this subject are cross-graded (i.e., pupils from two or more grades are in the same group). 1 2 3 4 5

21. All students are expected to learn the same amount of material or the same number of skills. 1 2 3 4 5

22. Pupils are grouped according to their interests in this subject. 1 2 3 4 5

23. Instruction is uniquely sequenced for each student in this subject area. 1 2 3 4 5

24. For instruction in this subject groups are heterogeneous. 1 2 3 4 5

25. Students take home their own texts to do their assigned homework. 1 2 3 4 5

26. Students are assigned skills kits exercises. 1 2 3 4 5

27. Manipulative aids are used to develop better understanding of math concepts. 1 2 3 4 5

28. Academic games are used. 1 2 3 4 5

29. I use the mathematics teachers' guide and continuum. 1 2 3 4 5

30. I use the county designed diagnostic and inventory tests. 1 2 3 4 5

31. I record pupil achievement on locally produced individual profile sheets. 1 2 3 4 5

32. Students are assigned drill and practice exercises. 1 2 3 4 5

INSTRUCTIONAL PRACTICES QUESTIONNAIRE

________________________________ Teacher Name

________________________________ School

I. General description of teaching situation:

1. In which type of setting do you teach science?

   Standard classroom (four solid walls) ________

   Portable classroom ________

   Pod or suite (two or more rooms with sliding walls between) ________

   Flexible or open space (two or more rooms with no walls between, solid or sliding) ________

   Other(Specify________________________________)

2. How many university courses have you taken in the teaching of science? Specify the number of courses (not credit hours) here: ________

3. How many years of science teaching experience do you have?

   0 - 2 years ________

   3 - 6 years ________

   7 or more ________

4. How many years have you taught at your present school?

   0 - 2 years ________

   3 - 6 years ________

   7 or more ________

II. Instructional methods used in your formal science program:

Please answer each of the following items according to the frequency a stated activity occurs in your teaching situation. If you do not teach formal (directed) science do not complete this section.

For each item, please circle the number next to the statement that best describes your situation. Use the following scale:

5 - Very frequently occurs
4 - Often occurs
3 - Sometimes occurs
2 - Rarely occurs
1 - Never occurs

1. Pupils within a class are grouped homogeneously on achievement or performance in this subject. 1 2 3 4 5
2. Teaching is directed to an entire class in this subject. 1 2 3 4 5
3. Instruction is directed to temporarily formed skills groups in this subject. 1 2 3 4 5
4. Students receive skills instruction through individual pupil-teacher conferences. 1 2 3 4 5
5. Pupil's progress proceeds at the pace of the group to which he is assigned. 1 2 3 4 5
6. Pupils are given individualized assignments only after they have completed the required group assignments. 1 2 3 4 5
7. Pupil's progress is paced by individually prepared prescriptions or contracts. 1 2 3 4 5
8. Pupils help plan assignments with teachers on a one-to-one basis. 1 2 3 4 5
9. Pupils maintain a record of their own progress. 1 2 3 4 5
10. Instruction is sequenced in this subject primarily on teacher judgment. 1 2 3 4 5
11. Instruction is sequenced in this subject according to a teachers' manual. 1 2 3 4 5
12. A variety of learning activities occur at the same time in this subject. 1 2 3 4 5
13. Pupils change skill groups as their performance changes. 1 2 3 4 5
14. Pupils are allowed to initiate studies in curriculum topics from a higher grade level whenever they are ready. 1 2 3 4 5
15. I plan my students' instruction with other teachers. 1 2 3 4 5

5 - Very frequently occurs
4 - Often occurs
3 - Sometimes occurs
2 - Rarely occurs
1 - Never occurs

16. My students have individual conferences with me at least once a week. 1 2 3 4 5

17. The same tests and other forms of evaluation are given to an entire class of pupils at the same time. 1 2 3 4 5

18. Pupils initiate changes in topics of study in this subject. 1 2 3 4 5

19. Diagnostic tests are given to pupils on an individual basis when pupils are ready to make changes in their programs of study. 1 2 3 4 5

20. Instructional groups in this subject are cross-graded (i.e., pupils from two or more grades are in the same group). 1 2 3 4 5

21. All students are expected to learn the same amount of material or the same number of skills. 1 2 3 4 5

22. Pupils are grouped according to their interests in this subject. 1 2 3 4 5

23. Instruction is uniquely sequenced for each student in this subject area. 1 2 3 4 5

24. For instruction in this subject groups are heterogeneous. 1 2 3 4 5

25. Students use a variety of books in their science instruction. 1 2 3 4 5

26. Reading and writing about different science topics is the chief mode of instruction. 1 2 3 4 5

27. Pupils record observations and data from their own experiences. 1 2 3 4 5

28. Commercially prepared science kits such a SCIS or ESS are used in addition to science textbooks. 1 2 3 4 5

29. Students use equipment and other science materials as a regular part of their science program. 1 2 3 4 5

30. Students conduct their own experiments. 1 2 3 4 5

APPENDIX G.

Communications with Test Publishers

March 26, 1973

Mrs. Baker
Thomas Nelson & Sons Ltd.
81 Curlew Drive
Don Mills, Ontario M3 A2 R1
Canada

Dear Mrs. Baker:

I wish to request permission to reproduce certain items from your Bristol Study Skills Tests. Presently I am a doctoral candidate at Nova University specializing in science education research. My study will essentially contrast the cognitive attainment of pupils coming from high individualized instructional programs with pupil attainment in low individualized programs. The dependent variable in this case will be an edited version of the Level One Bristol Study Skill Test. Actually as proposed, scores from the various Bristol subscales will be analyzed through various multivariate procedures such as MANOVA.

Last fall when I received copies of the Study Skills Tests I was immediately impressed with the process orientation of the Tests. Both my committee and I felt that these were the first commercially prepared tests that would measure pupils' cognitive attainment of inquiry skills associated with science. It was further hypothesized that pupils who experience science programs that involve many manipulative activities in an individualized setting should perform better on the Bristol than pupils that have traditional experiences. This became the foundation for my dissertation study.

However, in consultations with the various school personnel with whom I must work, concern about different items from the Bristol were expressed. For instance, several of the items were challenged due to cultural differences in terminology; others were thought to be somewhat unclear for the majority of students. Thus, though negotiations with school personnel, a scaled down version of Form B with the addition of some items from Form A Level One has evolved. Enclosed is a copy o the test as I wish to use it in my study. As you can see, full acknowledgement to your firm will be given, togbther with a statement indicating that permission to use the instrument has been granted.

In return for permission to reproduce these test items I would furnish your firm with a copy of the results of the study.

If I can provide further information do not hesitate to contact me here at the university. Thank you for your assistance in this matter.

Sincerely,

Marvin D. Patterson
Research Fellow

MDP/cjr
Enclosure

Thomas Nelson & Sons
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March 29th 1973

Mr. Marvin D. Patterson,
Research Fellow,
Nova University Behavioral Sciences Center,
College Avenue,
Fort Lauderdale, Florida 33314,
U.S.A.

Dear Mr. Patterson:

Thank you for your letter of March 26th concerning permission to reproduce certain items from the BRISTOL STUDY SKILLS TESTS. The copyright on these Tests is held by Thomas Nelson & Sons Limited, 36 Park Street, London W1Y 4DE, and I am forwarding your request to them since permission must come from them.

Yours truly,
THOMAS NELSON & SONS (CANADA) LIMITED

Phyllis Baker

Mrs.Phyllis Baker

pb:

cc. Mr. Peter Belbin,
Thomas Nelson & Sons Limited,
36 Park Street, London W1Y 4DE
England.

with attachments.

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APPENDIX H.

Classification of IPQ Key Items

Coding of key IPQ questions by dimension of individualized instruction:

5- Variety of methods
4- Sequence of content
3- Rates of learning
2- Amount of content
1- Variety of content

2.	Teaching is directed to an entire class in this subject.	①	②	③	④	⑤
5.	Pupil's progress proceeds at the pace of the group to which he is assigned.	1	2	③	4	5
7.	Pupil's progress is paced by individually prepared prescriptions or contracts.	1	2	③	4	5
8.	Pupils help plan assignments with teachers on a one-to-one basis.	①	②	③	④	⑤
12.	A variety of learning activities occur at the same time in this subject.	1	2	3	4	⑤
14.	Pupils are allowed to initiate studies in curriculum topics from a higher grade level whenever they are ready.	①	2	③	④	5
17.	The same tests and other forms of evaluation are given to an entire class of pupils at the same time.	①	②	③	4	⑤
18.	Pupils initiate changes in topics of study in this subject.	①	②	3	④	⑤
19.	Diagnostic tests are given to pupils on an individual basis when pupils are ready to make changes in their programs of study.	1	②	③	4	⑤
21.	All students are expected to learn the same amount of material or the same number of skills.	1	②	③	4	5
23.	Instruction is uniquely sequenced for each student in this subject area.	1	2	3	④	5

APPENDIX I

Factor Loadings of IPQ

TABLE 3.2

FACTOR LOADINGS ON KEY IPQ ITEMS*

(Reading Teachers (N=298) and Math Teachers (N=270))

	Factor 1		Factor 2	
Item #	Math T.	Reading T.	Math T.	Reading T.
2	.47	.28	.70	.75
5	.35	.34	.20	.20
7	.75	.75	-.13	-.24
8	.66	.65	-.33	.19
12	.53	.43	-.25	-.01
14	.62	.63	-.26	-.07
17	.44	.33	.74	.77
18	.43	.50	-.36	-.34
19	.72	.70	-.09	-.13
21	.51	.46	.54	.51
23	.70	.63	-.25	-.25

*Items 2, 5, 17 and 21 were reversed prior to running the factor analysis

TABLE 3.3

BEFORE ROTATION

FACTOR LOADINGS ON IPQ COMMON ITEMS *

(Reading Teachers (N=298) and Math Teachers (N=270))

	Factor 1			Factor 2		
Item #	Math	Reading	Both	Math	Reading	Both
1	-.10	-.31	-.18	.06	.21	.12
2	-.35	-.15	-.25	.67	.61	.62
3	.32	.33	.32	-.01	-.10	-.06
4	.50	.54	.52	.13	.18	.15
5	-.29	-.26	-.26	.38	.47	.43
6	-.16	-.18	-.17	.42	.42	.43
7	.76	.73	.74	.00	.10	.07
8	.71	.68	.69	.19	.00	.10
9	.62	.51	.56	.12	.05	.09
10	-.27	-.14	-.20	.19	.22	.08
11	-.05	-.20	-.12	.42	.49	.44
12	.55	.41	.49	.14	.09	.08
13	.54	.47	.50	.01	.23	.12
14	.63	.59	.62	.15	.03	.08
15	.28	.24	.27	.14	.09	.11
16	.68	.66	.66	.12	.00	.05
17	-.31	-.20	-.26	.72	.70	.71
18	.46	.50	.48	.26	.18	.22
19	.70	.64	.66	-.04	.05	-.01
20	.20	.29	.25	.28	.30	.30
21	-.40	-.35	-.37	.64	.51	.59
22	.38	.44	.42	.18	.20	.18
23	.70	.65	.67	.09	.17	.13
24	.22	.33	.27	.25	.17	.21

*Negatively worded items were not reversed prior to running this principal components analysis.

APPENDIX J.

Histograms of IPQ Scores in Reading and Mathematics

Teacher Distribution on Reading IPQ

```
VARIABLE NUM   1  LOWEST SCORE =  16.0  HIGHEST SCORE =  51.0  SCALE = X 1

RANGE =   36.0  MEAN =   36.8 STANDARD DEVIATION =    6.3 STAN ERROR =  0.36 NUM SUBJ =  298

 CUM FREQ FREQ      RANGE        .............................................................
   1  298    1  15.50 -  16.50 X
   1  297    0  16.50 -  17.50
   1  297    0  17.50 -  18.50
   2  297    1  18.50 -  19.50 X
   2  296    0  19.50 -  20.50
   4  296    2  20.50 -  21.50 XX
   5  294    1  21.50 -  22.50 X
   5  293    0  22.50 -  23.50
   9  293    4  23.50 -  24.50 XXXX
  13  289    4  24.50 -  25.50 XXXX
  16  285    3  25.50 -  26.50 XXX
  23  282    7  26.50 -  27.50 XXXXXXX
  30  275    7  27.50 -  28.50 XXXXXXX
  34  268    4  28.50 -  29.50 XXXX
  44  264   10  29.50 -  30.50 XXXXXXXXXX
  56  254   12  30.50 -  31.50 XXXXXXXXXXXX
  75  242   19  31.50 -  32.50 XXXXXXXXXXXXXXXXXXX
  92  223   17  32.50 -  33.50 XXXXXXXXXXXXXXXXX
 105  206   13  33.50 -  34.50 XXXXXXXXXXXXX
 127  193   22  34.50 -  35.50 XXXXXXXXXXXXXXXXXXXXXX
 138  171   11  35.50 -  36.50 XXXXXXXXXXX
 158  160   20  36.50 -  37.50 XXXXXXXXXXXXXXXXXXXX
 179  140   21  37.50 -  38.50 XXXXXXXXXXXXXXXXXXXXX
 194  119   15  38.50 -  39.50 XXXXXXXXXXXXXXX
 210  104   16  39.50 -  40.50 XXXXXXXXXXXXXXXX
 230   88   20  40.50 -  41.50 XXXXXXXXXXXXXXXXXXXX
 246   68   16  41.50 -  42.50 XXXXXXXXXXXXXXXX
 259   52   13  42.50 -  43.50 XXXXXXXXXXXXX
 263   39    4  43.50 -  44.50 XXXX
 270   35    7  44.50 -  45.50 XXXXXXX
 281   28   11  45.50 -  46.50 XXXXXXXXXXX
 287   17    6  46.50 -  47.50 XXXXXX
 289   11    2  47.50 -  48.50 XX
 295    9    6  48.50 -  49.50 XXXXXX
 297    3    2  49.50 -  50.50 XX
 298    1    1  50.50 -  51.50 X
```

School Distributions On Reading IPQ

```
VARIABLE NUM   1  LOWEST SCORE =  26.1  HIGHEST SCORE =  46.5  SCALE = X 1

RANGE =   21.4  MEAN =   37.3 STANDARD DEVIATION =    4.3 STAN ERROR =  0.56 NUM SUBJ =   59


   **PRINTING OF INTERVALS WITH ZERO FREQUENCY HAS BEEN SUPPRESSED**


 CUM FREQ FREQ      RANGE       .................................................................
   1   59   1  25.60 -  26.60 X         School 30
   2   58   1  27.60 -  28.60 X
   3   57   1  28.60 -  29.60 X
   4   56   1  29.60 -  30.60 X         School 10
   6   55   2  30.60 -  31.60 XX        School 20
  10   53   4  31.60 -  32.60 XXXX
  15   49   5  32.60 -  33.60 XXXXX
  19   44   4  33.60 -  34.60 XXXX
  24   40   5  34.60 -  35.60 XXXXX
  27   35   3  35.60 -  36.60 XXX
  30   32   3  36.60 -  37.60 XXX
  39   29   9  37.60 -  38.60 XXXXXXXXX
  43   20   4  38.60 -  39.60 XXXX
  47   16   4  39.60 -  40.60 XXXX
  50   12   3  40.60 -  41.60 XXX
  54    9   4  41.60 -  42.60 XXXX
  56    5   2  42.60 -  43.60 XX        School 60, School 70
  58    3   2  43.60 -  44.60 XX        School 40, School 50
  59    1   1  45.60 -  46.60 X
```

Teacher Distribution for Math IPQ

```
VARIABLE NUM   1  LOWEST SCORE =  17.0  HIGHEST SCORE =  51.0  SCALE = X 1

RANGE =    35.0  MEAN =    35.2 STANDARD DEVIATION =    6.7 STAN ERROR =  0.41 NUM SUBJ =  270


   **PRINTING OF INTERVALS WITH ZERO FREQUENCY HAS BEEN SUPPRESSED**


 CUM FREQ FREQ      RANGE         ..........................................................................................
   2  270   2  16.50 -  17.50 XX
   3  268   1  19.50 -  20.50 X
   7  267   4  20.50 -  21.50 XXXX
  10  263   3  21.50 -  22.50 XXX
  14  260   4  22.50 -  23.50 XXXX
  17  256   3  23.50 -  24.50 XXX
  20  253   3  24.50 -  25.50 XXX
  27  250   7  25.50 -  26.50 XXXXXXX
  34  243   7  26.50 -  27.50 XXXXXXX
  37  236   3  27.50 -  28.50 XXX
  47  233  10  28.50 -  29.50 XXXXXXXXXX
  54  223   7  29.50 -  30.50 XXXXXXX
  69  216  15  30.50 -  31.50 XXXXXXXXXXXXXXX
  94  201  25  31.50 -  32.50 XXXXXXXXXXXXXXXXXXXXXXXXX
 112  176  18  32.50 -  33.50 XXXXXXXXXXXXXXXXXX
 131  158  19  33.50 -  34.50 XXXXXXXXXXXXXXXXXXX
 150  139  19  34.50 -  35.50 XXXXXXXXXXXXXXXXXXX
 166  120  16  35.50 -  36.50 XXXXXXXXXXXXXXXX
 174  104   8  36.50 -  37.50 XXXXXXXX
 191   96  17  37.50 -  38.50 XXXXXXXXXXXXXXXXX
 204   79  13  38.50 -  39.50 XXXXXXXXXXXXX
 211   66   7  39.50 -  40.50 XXXXXXX
 221   59  10  40.50 -  41.50 XXXXXXXXXX
 229   49   8  41.50 -  42.50 XXXXXXXX
 238   41   9  42.50 -  43.50 XXXXXXXXX
 242   32   4  43.50 -  44.50 XXXX
 247   28   5  44.50 -  45.50 XXXXX
 256   23   9  45.50 -  46.50 XXXXXXXXX
 261   14   5  46.50 -  47.50 XXXXX
 263    9   2  47.50 -  48.50 XX
 265    7   2  48.50 -  49.50 XX
 269    5   4  49.50 -  50.50 XXXX
 270    1   1  50.50 -  51.50 X
```

School Distributions on Math IPQ

```
VARIABLE NUM   1  LOWEST SCORE =  26.6  HIGHEST SCORE =  50.0  SCALE = X 1

RANGE =   24.4  MEAN =   36.1 STANDARD DEVIATION =     4.9 STAN ERROR =  0.64 NUM SUBJ =   60

 CUM FREQ FREQ      RANGE          .........
   2   60   2  26.10 -  27.10 XX          School 30
   5   58   3  27.10 -  28.10 XXX
   7   55   2  28.10 -  29.10 XX
   7   53   0  29.10 -  30.10
   8   53   1  30.10 -  31.10 X
  13   52   5  31.10 -  32.10 XXXXX       School 10
  16   47   3  32.10 -  33.10 XXX
  22   44   6  33.10 -  34.10 XXXXXX
  27   38   5  34.10 -  35.10 XXXXX
  35   33   8  35.10 -  36.10 XXXXXXXX    School 20
  38   25   3  36.10 -  37.10 XXX
  41   22   3  37.10 -  38.10 XXX         School 50
  48   19   7  38.10 -  39.10 XXXXXXX     School 70
  50   12   2  39.10 -  40.10 XX
  53   10   3  40.10 -  41.10 XXX
  55    7   2  41.10 -  42.10 XX
  57    5   2  42.10 -  43.10 XX          School 40
  57    3   0  43.10 -  44.10
  58    3   1  44.10 -  45.10 X
  58    2   0  45.10 -  46.10
  58    2   0  46.10 -  47.10
  58    2   0  47.10 -  48.10
  58    2   0  48.10 -  49.10
  60    2   2  49.10 -  50.10 XX          School 60

ET=000.28
```

IPQ Scores for Reading and Math: School Sums

```
VARIABLE NUM   1  LOWEST SCORE =  52.7  HIGHEST SCORE =  92.8  SCALE = X 1

RANGE =   41.1  MEAN =   73.5 STANDARD DEVIATION =    8.1 STAN ERROR = 1.06 NUM SUBJ =   59

 CUM FREQ FREQ      RANGE        .............................................................
   1   59   1  52.20 -  53.20 X        School 30
   1   58   0  53.20 -  54.20
   1   58   0  54.20 -  55.20
   2   58   1  55.20 -  56.20 X
   2   57   0  56.20 -  57.20
   2   57   0  57.20 -  58.20
   2   57   0  58.20 -  59.20
   2   57   0  59.20 -  60.20
   3   57   1  60.20 -  61.20 X
   7   56   4  61.20 -  62.20 XXXX     School 10
   8   52   1  62.20 -  63.20 X
   8   51   0  63.20 -  64.20
  10   51   2  64.20 -  65.20 XX
  12   49   2  65.20 -  66.20 XX
  13   47   1  66.20 -  67.20 X        School 20
  17   46   4  67.20 -  68.20 XXXX
  19   42   2  68.20 -  69.20 XX
  21   40   2  69.20 -  70.20 XX
  23   38   2  70.20 -  71.20 XX
  26   36   3  71.20 -  72.20 XXX
  29   33   3  72.20 -  73.20 XXX
  31   30   2  73.20 -  74.20 XX
  35   28   4  74.20 -  75.20 XXXX
  36   24   1  75.20 -  76.20 X
  37   23   1  76.20 -  77.20 X
  41   22   4  77.20 -  78.20 XXXX
  45   18   4  78.20 -  79.20 XXXX
  47   14   2  79.20 -  80.20 XX
  51   12   4  80.20 -  81.20 XXXX
  54    8   3  81.20 -  82.20 XXX      School 50, School 70
  54    5   0  82.20 -  83.20
  56    5   2  83.20 -  84.20 XX
  56    3   0  84.20 -  85.20
  56    3   0  85.20 -  86.20
  57    3   1  86.20 -  87.20 X
  58    2   1  87.20 -  88.20 X        School 40
  58    1   0  88.20 -  89.20
  58    1   0  89.20 -  90.20
  58    1   0  90.20 -  91.20
  58    1   0  91.20 -  92.20
  59    1   1  92.20 -  93.20 X        School 60
```

APPENDIX K.

Principals' Packet

NOTE: Please give this sheet to the teacher who will be administering the teacher instruments.

DIRECTIONS FOR ADMINISTRATION OF THE TEACHER QUESTIONNAIRES

As a representative of the fifth-year teachers of science in your school, the Research Department is asking you to take charge of the administration of these teacher instruments.

In order to put the teachers more at ease when completing these questionnaires, we are asking that neither the principal nor the guidance counselor have anything to do with their administration or collection.

As the teacher representative of your school, we are asking you to complete the following steps with the group of teachers:

1. Please make sure that no administrative person is present while the instruments are being completed.
2. Read the following statement of purpose to the group:

   "The purpose of the Instructional Practices Questionnaire is to allow you to describe your instructional approaches in science. The purpose of the second questionnaire, Ideas About Teaching and Learning, is to allow you to express your beliefs and opinions about teaching-learning processes.

   While the instruments are not anonymous, responses will be completely confidential. Also, as soon as possible, the treatment of the information will be made anonymous. The information we gather is not going to be used in any type of individual teacher or principal evaluation."
3. Do not distribute questionnaires to temporary substitute teachers.
4. Have teachers read the cover sheet and if any serious problems arise, please call the Research Department (525-7617).
5. Make sure that teachers put their name and the name of the school on the top of each questionnaire immediately as a first step.
6. Please announce that collaboration with other teachers is not encouraged even though they may be teaching in a team situation.

7. Have all teachers complete the questionnaires as per instructions within the instruments. This questionnaire should be completed in one sitting. Do not allow teachers to take them home.
8. Collect the instruments and make sure that they are properly identified and completed.
9. Any teacher who is absent should be asked to complete the questionnaires as soon as he or she returns.
10. Please return all questionnaires to the school office. The questionnaires are due back in the school office by May 15, 1973.

Dear Teacher:

The attached questionnaire is designed to gather information about how teachers in selected Broward County schools approach their instruction in science. The results should be helpful to us in understanding local instructional practices and in relating these to student outcomes.

Your responses to this questionnaire will be regarded as confidential. Only personnel in the Research Department will handle these data. When necessary linkages with data concerning student outomes, etc., have been made, the need for your names will disappear and the treatment of this information will be made anonymous. Be assured that we will deal with the responses on a group basis. No individual teachers will be identified. The information gathered will not be used in any type of teacher or principal evaluation. The questionnaires need to have teacher names on them since we wish to study how certain instructional practices relate to student outcomes. Again, these relationships will be studied and reported on a group basis.

In filling out this questionnaire, you should do so independently. Collaboration with other teachers is not encouraged even though you may be team teaching with other teachers. Since this is a survey of instructional practices, it is desired that you indicate your own personal approach regardless of whether you think others would approve or disapprove of your response. The best response is the response that best describes your approach.

The teacher instrument should be administered at one session. It is our suggestion that fifth-year teachers of science be asked to complete this questionnaire in lieu of a regular faculty meeting. The principal and guidance counselor should not be present at this meeting. The teachers should choose a representative from among themselves to distribute the questionnaires and to collect them and return them to your school office.

If these instructions are not clear or if your school has an unusual situation, please feel free to call Julian Biller at 525-7617.

Your cooperation is greatly appreciated.

Bill Meredith
Director of Research

INSTRUCTIONS FOR TEST ADMINISTRATION

Overview:

Enclosed are two instruments to be given to fifth year students, The Bristol Study Skills Test and The Student Questionnaire. The Bristol test is designed to measure students' abilities to make inferences about materials and situations. The questionnaire is designed to tap students' perceptions of how they study science. The Bristol test takes 45 minutes to administer while the questionnaire takes 10 minutes or less. The Student Questionnaire should be given before the Bristol. It is highly desirable to give both instruments on the same day. It is also desirable to have all students tested on the same day at the same time. Procedures for make up testing of absentees will be worked out at each school.

Conditions For Testing:

The mental and physical well-being of the children affects their performances on the tests. Temperature, lighting, ventilation, sitting and writing positions, auditory or visual distractions, time of the day, previous activity are all obvious sources of influence on test performance. The less obvious influences are equally important, the demeanour of the administrator, his or her clarity of speech, friendliness and firmness of manner, familiarity with the test and instructions, and efficient preparation of the room for testing. All that can be done by the administrator to create conditions which are conducive to maximal test performances should be attempted.

Students should be spaced as far apart as conditions permit, and all unnecessary materials removed from the tables or desks. Each child should have a sharpened pencil or a ball point pen and a reserve of pencils should be on hand. If more than 30 children are being tested in the same room, it is preferable to have an assistant ready to help children in difficulty over the test routine.

The time control is an essential aspect of the test performance and is particularly important for the profile of part scores. The greatest care must therefore be taken to ensure that the timing instructions are followed and that an accurate watch with a seconds hand is available to the test administrator.

Administration of the Student Questionnaire:

When all children are comfortably seated, give out the Student Questionnaires face down telling the students to wait for instructions. Then ask the students to turn their questionnaires face up and fill in their own name and the name of the teacher who teaches them science. Next read the instructions, "These questions have no right or wrong answers. Please check the one response which best tells how you study science." Then say, "Are there any questions?" After all reasonable questions, ask them to begin. Give the group ten minutes to complete the questionnaire.

When ten minutes have passed, ask the students who have completed the questionnaires to turn them face down in front of them. Students who have not finished completing the questionnaire may do so while the Bristol is being passed out. When all Bristol tests have been distributed, ask those students still working on the questionnaire to stop and turn the questionnaires face down in front of them. Students are to keep the questionnaires face down in front of them until the end of the test session. When the Bristol testing is completed, students will place the questionnaires inside their Bristol booklets.

Administration of the Bristol Test:

Give out the booklets front page uppermost, telling the children that they may read the front page but must not turn over.

The personal data should then be written in by the children. Age may be left blank. Help should be given in filling in the details by guiding the children through the entries, but without making the process too formal.

Then, pointing to the section, "How to work this test," say "Follow while I read these instructions to you." Then read the section on the front page. Afterwards say, "Are there any questions?" Answer all reasonable questions about procedure in accordance with the instructions then say, "Turn over and begin on Part 1." Note the exact time at which you say "Begin" and record what the time will be at the end of 9 minutes, 18 minutes, 27 minutes, 36 minutes and 45 minutes.

AFTER	SAY
9 minutes	"If you have not finished Part 1 leave it now and go on to Part 2, question number 13."
18 minutes	"If you have not finished Part 2 leave it now and go on to Part 3, question number 25."
27 minutes	"If you have not finished Part 3 leave it now and go on to Part 4, question number 32."
36 minutes	"If you have not finished Part 4 leave it now and go on to Part 5, question number 38. If you finish before time is up look over what you have done earlier."
45 minutes	"Stop working, put your pencils down and close your books."

During the course of the testing, children should be given all possible help with procedure, but should not be told what words mean or how to get the answer to a question.

Collection of Tests:

Ask the students to look at the Bristol and the questionnaire to make sure their name is on both forms. Ask the students to place their questionnaire safely inside the Bristol booklet just completed. Collect all booklets.

Note to the Reader:

Also included in the Principals' Packet were examples of all the instruments utilized in the study. These Instruments can be found in the following Appendices:

Appendix A: Instructional Practices Questionnaire
Appendix B: Ideas About Teaching and Learning
Appendix C: Bristol Study Skills Test
Appendix D: Student Questionnaire

Copies of these were not included in this appendix for the sake of brevity.

APPENDIX L.

Feedback Materials to Schools

NOVA UNIVERSITY COLLEGE AVENUE, FORT LAUDERDALE, FLORIDA 33314 • 305/587-6660

June 6, 1973

Dear Principal:

Under separate cover I have sent the test results of the Bristol test to your fifth grade teachers. Included with the results was a statement interpreting the five subscores and total score.

The cooperation of you and your staff has been terrific. Thank you all for your help in this effort.

If there is additional information relative to the testing that I could provide, please do not hesitate to contact me.

Thanks again for everything.

Cordially,

Mary Patterson

MP:lsa

NOVA UNIVERSITY COLLEGE AVENUE, FORT LAUDERDALE, FLORIDA 33314 • 305/587-6660

June 5, 1973

Dear Cooperating Teachers:

Enclosed are the Bristol test results for your school. A series of computer printouts are provided. The first is a list of students, their subscores on the five parts of the Bristol and their total Bristol score. To understand the subscores you should refer to the attached quotation from the interpretive manual.

The second printout is a histogram showing the distribution of test scores for your school. It also indicates the mean (or average score) and other data for your school. Even though all of the test booklets from other schools have not as yet been scored, you can make some comparisons. As of this date 747 tests have been hand scored. The mean for the entire group is 26.1, the median 28 and the range from 3-45.

The last printouts are histograms showing the distribution of test scores for each fifth grade teacher that teaches science at your school.

Your cooperation and assistance in this study is greatly appreciated. The last weeks of school are especially busy for teachers so I was particularly grateful for your efforts in May. I hope the enclosed information will be of some use to you.

Cordially,

Marv Patterson

MP:lsa
Enclosures

Study skills

In many ways the study skills tests represent the most ambitious of the three areas of achievement measurement attempted by the Bristol Achievement Tests. As the term "study skills" implies, they attempt to assess the kind and degree of application that children can bring to bear to study of the world around them and particularly within those areas of the curriculum which are normally covered by environmental studies and natural sciences.

They necessarily involve particular knowledge which may be gained either from experience outside school or from deliberate teaching inside school. Nevertheless, in great measure they focus on the concepts and skills involved in working with and learning from representations of the environment. Various degrees of abstraction from real life situations are employed. Pictorial, linguistic, diagrammatic, cartographical, and numerical reference systems are employed. The most frequent comment from teachers who have used the tests is their surprise that, despite the absence in their curriculum of skills and content relevant to the tests, children perform well on them. They are a salutory reminder to teachers of how much learning goes on outside school and how much is available in the child's experience upon which other aspects of the school curriculum might be built.

Like the sectionalising of the English and mathematics tests, the sectionalising of the study skills tests refers more to constructs which are conceived to be educationally valuable than those which are factorially distinct.

Part 1 of each test deals with the properties of materials and situations. The theme which links the diverse items included in Part 1 is that of linguistic reference to the qualities implicit in effective ways of conceiving of materials and of situations. The presentation of each item is in some cases entirely linguistic and in others is partly diagrammatic. Acquaintance with the conventions of pictorial, diagrammatic and cartographical representation of things and situations is considered to be a vital part of the study skills to be sought. Clearly the success of a child in this section is dependent upon the quality of the direct experience available to him, the vocabulary he has at his disposal, and the concepts that he has developed. As in the other sections only a small sample of the possible content can be represented and no claim is made that this is the essential content of environmental study and natural science elements in the curriculum for each level.

Part 2 is concerned with structures, that is to say, with space in which there are articulated parts and where the questions concern the relationships of these parts to each other and to the whole. Practical judgements are invited of balance, area, location, shape, size, distance and direction of movement. The experienced teacher will recognise implicit in these items many of the common difficulties which beset children in handling part-whole relationships in space.

While some of the items of Part 3 may seem at first sight to be indistinguishable from those of Part 2 they will be found on closer inspection to differ in that Part 3 focuses on processes which involve a sequence or a trend where it is not merely the direction or the articulation of parts which is considered, but the projection or interpolation in processes which involve a sequence of events. It is not so much that Part 3 excludes those things which are dealt with in Part 2 but rather that it adds a further requirement. The other major difference between Part 3 and Part 2 is the much greater range of content implicit in looking at something which is not merely represented by process in space. The sequence of events in time is just as important. Here again the range of possible content is immense and the sample represented by the tests should be taken to be illustrative of what the curriculum might include rather than as indicating the essential elements within it.

Part 4 is entitled "explanations" because its main theme is "ways of accounting for experience". Into this section come many of the familiar problems of conservation, of the distinction between animate and inanimate and, in the later levels, of scientific reasoning. It is not possible to exclude completely dependence upon specifically taught knowledge. However, the emphasis in each item is upon the ways of conceptualising, classifying and reasoning through situations involving natural phenomena, time and space.

Part 5 is called "interpretations" because it focuses on inferences made from diagrammatically and symbolically presented data. In this sense, Part 5 represents the highest level of abstraction in the tests in that the child is required to accept that summarised data can represent collected evidence from which legitimate inference can be made and appropriate judgements about the situations which the summary represents are possible.

School Results

```
VARIABLE NUM   1  LOWEST SCORE =    4.0  HIGHEST SCORE =  43.0  SCALE = X 1

RANGE =   40.0  MEAN =   28.4 STANDARD DEVIATION =    9.3 STAN ERROR =  0.75 NUM SUBJ =  154


  **PRINTING OF INTERVALS WITH ZERO FREQUENCY HAS BEEN SUPPRESSED**


CUM FREQ FREQ      RANGE      ..................................................................................
  1  154    1   3.50 -   4.50 X
  2  153    1   5.50 -   6.50 X
  3  152    1   6.50 -   7.50 X
  4  151    1   7.50 -   8.50 X
  7  150    3   9.50 -  10.50 XXX
  9  147    2  10.50 -  11.50 XX
 12  145    3  11.50 -  12.50 XXX
 17  142    5  12.50 -  13.50 XXXXX
 18  137    1  13.50 -  14.50 X
 19  136    1  14.50 -  15.50 X
 22  135    3  15.50 -  16.50 XXX
 26  132    4  16.50 -  17.50 XXXX
 28  128    2  17.50 -  18.50 XX
 31  126    3  19.50 -  20.50 XXX
 33  123    2  20.50 -  21.50 XX
 41  121    8  21.50 -  22.50 XXXXXXXX
 42  113    1  22.50 -  23.50 X
 44  112    2  23.50 -  24.50 XX
 46  110    2  24.50 -  25.50 XX
 52  108    6  25.50 -  26.50 XXXXXX
 61  102    9  26.50 -  27.50 XXXXXXXXX
 69   93    8  27.50 -  28.50 XXXXXXXX
 73   85    4  28.50 -  29.50 XXXX
 82   81    9  29.50 -  30.50 XXXXXXXXX
 91   72    9  30.50 -  31.50 XXXXXXXXX
 95   63    4  31.50 -  32.50 XXXX
103   59    8  32.50 -  33.50 XXXXXXXX
107   51    4  33.50 -  34.50 XXXX
113   47    6  34.50 -  35.50 XXXXXX
124   41   11  35.50 -  36.50 XXXXXXXXXXX
129   30    5  36.50 -  37.50 XXXXX
135   25    6  37.50 -  38.50 XXXXXX
138   19    3  38.50 -  39.50 XXX
145   16    7  39.50 -  40.50 XXXXXXX
149    9    4  40.50 -  41.50 XXXX
152    5    3  41.50 -  42.50 XXX
154    2    2  42.50 -  43.50 XX

ET=000.56
```

Teacher Results

```
VARIABLE NUM   1  LOWEST SCORE =   8.0  HIGHEST SCORE =  42.0  SCALE = X 1

RANGE =   35.0  MEAN =   29.1 STANDARD DEVIATION =    9.0 STAN ERROR =  1.24 NUM SUBJ =   53


   **PRINTING OF INTERVALS WITH ZERO FREQUENCY HAS BEEN SUPPRESSED**


 CUM FREQ FREQ     RANGE        ..............................................................................................
   1   53   1   7.50 -    8.50 X
   3   52   2  10.50 -   11.50 XX
   4   50   1  13.50 -   14.50 X
   6   49   2  15.50 -   16.50 XX
   9   47   3  16.50 -   17.50 XXX
  10   44   1  19.50 -   20.50 X
  12   43   2  20.50 -   21.50 XX
  14   41   2  21.50 -   22.50 XX
  15   39   1  23.50 -   24.50 X
  16   38   1  25.50 -   26.50 X
  19   37   3  26.50 -   27.50 XXX
  22   34   3  27.50 -   28.50 XXX
  24   31   2  28.50 -   29.50 XX
  28   29   4  29.50 -   30.50 XXXX
  32   25   4  30.50 -   31.50 XXXX
  35   21   3  32.50 -   33.50 XXX
  36   18   1  33.50 -   34.50 X
  40   17   4  35.50 -   36.50 XXXX
  43   13   3  36.50 -   37.50 XXX
  44   10   1  37.50 -   38.50 X
  46    9   2  38.50 -   39.50 XX
  48    7   2  39.50 -   40.50 XX
  51    5   3  40.50 -   41.50 XXX
  53    2   2  41.50 -   42.50 XX

ET=000.27
```

— Student Results —

SID	STUDENT		SUBSCORES					TOT. SCORE
		Part %	I	II	III	IV	V	
[redacted]	[redacted]		5	5	3	4	6	23
[redacted]	[redacted]		10	6	4	4	6	30
[redacted]	[redacted]		10	7	5	3	3	28
[redacted]	[redacted]		6	3	5	2	7	23
[redacted]	[redacted]		8	5	5	4	8	30
[redacted]	[redacted]		8	9	4	5	8	34
[redacted]	[redacted]		7	9	5	0	5	26
[redacted]	[redacted]		10	12	6	6	8	42
[redacted]	[redacted]		10	8	5	2	3	28
[redacted]	[redacted]		7	8	5	5	6	31
[redacted]	[redacted]		7	2	3	4	6	22
[redacted]	[redacted]		7	1	5	2	1	16
[redacted]	[redacted]		8	5	4	3	8	28
[redacted]	[redacted]		2	0	1	4	3	10
[redacted]	[redacted]		6	5	6	4	6	27
[redacted]	[redacted]		9	11	6	4	8	38
[redacted]	[redacted]		9	7	6	5	6	33
[redacted]	[redacted]		5	9	7	5	8	34
[redacted]	[redacted]		8	6	6	4	7	31
[redacted]	[redacted]		9	7	4	5	6	31
[redacted]	[redacted]		9	6	5	5	8	33

APPENDIX M.

Student Distributions on Bristol Parts and Total

TABLE 4.5

Bristol Distribution
of Total Scores

```
VARIABLE NO.  6 . LOWEST SCØRE =   1.0  HIGHEST SCØRE =  45.0  SCALE = X 1

RANGE =   45.0  MEAN =   25.7 STANDARD DEVIATIØN =    9.3 STAN ERRØR =  0.31 NUM SUBJ =  903


   **PRINTING ØF INTERVALS WITH ZERØ FREQUENCY HAS BEEN SUPPRESSED**


 CUM FREQ FREQ      RANGE         .....................................................................
   1  903   1   0.50 -   1.50 X
   4  902   3   2.50 -   3.50 XXX
  10  899   6   3.50 -   4.50 XXXXXX
  17  893   7   4.50 -   5.50 XXXXXXX
  23  886   6   5.50 -   6.50 XXXXXX
  31  880   8   6.50 -   7.50 XXXXXXXX
  40  872   9   7.50 -   8.50 XXXXXXXXX
  56  863  16   8.50 -   9.50 XXXXXXXXXXXXXXXX
  68  847  12   9.50 -  10.50 XXXXXXXXXXXX
  88  835  20  10.50 -  11.50 XXXXXXXXXXXXXXXXXXXX
 101  815  13  11.50 -  12.50 XXXXXXXXXXXXX
 121  802  20  12.50 -  13.50 XXXXXXXXXXXXXXXXXXXX
 130  782   9  13.50 -  14.50 XXXXXXXXX
 150  773  20  14.50 -  15.50 XXXXXXXXXXXXXXXXXXXX
 167  753  17  15.50 -  16.50 XXXXXXXXXXXXXXXXX
 188  736  21  16.50 -  17.50 XXXXXXXXXXXXXXXXXXXXX
 209  715  21  17.50 -  18.50 XXXXXXXXXXXXXXXXXXXXX
 232  694  23  18.50 -  19.50 XXXXXXXXXXXXXXXXXXXXXXX
 267  671  35  19.50 -  20.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 287  636  20  20.50 -  21.50 XXXXXXXXXXXXXXXXXXXX
 316  616  29  21.50 -  22.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 338  587  22  22.50 -  23.50 XXXXXXXXXXXXXXXXXXXXXX
 359  565  21  23.50 -  24.50 XXXXXXXXXXXXXXXXXXXXX
 397  544  38  24.50 -  25.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 423  506  26  25.50 -  26.50 XXXXXXXXXXXXXXXXXXXXXXXXXX
 461  480  38  26.50 -  27.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 510  442  49  27.50 -  28.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 542  393  32  28.50 -  29.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 594  361  52  29.50 -  30.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 636  309  42  30.50 -  31.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 674  267  38  31.50 -  32.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 716  229  42  32.50 -  33.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 746  187  30  33.50 -  34.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 774  157  28  34.50 -  35.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXX
 799  129  25  35.50 -  36.50 XXXXXXXXXXXXXXXXXXXXXXXXX
 821  104  22  36.50 -  37.50 XXXXXXXXXXXXXXXXXXXXXX
 847   82  26  37.50 -  38.50 XXXXXXXXXXXXXXXXXXXXXXXXXX
 861   56  14  38.50 -  39.50 XXXXXXXXXXXXXX
 876   42  15  39.50 -  40.50 XXXXXXXXXXXXXXX
 887   27  11  40.50 -  41.50 XXXXXXXXXXX
 897   16  10  41.50 -  42.50 XXXXXXXXXX
 902    6   5  42.50 -  43.50 XXXXX
 903    1   1  44.50 -  45.50 X
```

TABLE 4.6

Bristol Part I Distribution

```
VARIABLE NUM   1  LOWEST SCORE =   0.0  HIGHEST SCORE =  12.0  SCALE = X 2

RANGE =   13.0  MEAN =     7.2 STANDARD DEVIATION =    2.7 STAN ERROR =  0.09 NUM SUBJ =  903


   **PRINTING OF INTERVALS WITH ZERO FREQUENCY HAS BEEN SUPPRESSED**


 CUM FREQ FREQ      RANGE       .....................................................................
  11  903  11  -0.50 -    0.50 XXXXX
  23  892  12   0.50 -    1.50 XXXXXX
  51  880  28   1.50 -    2.50 XXXXXXXXXXXXXX
  92  852  41   2.50 -    3.50 XXXXXXXXXXXXXXXXXXXX
 144  811  52   3.50 -    4.50 XXXXXXXXXXXXXXXXXXXXXXXXXX
 226  759  82   4.50 -    5.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 322  677  96   5.50 -    6.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 442  581 120   6.50 -    7.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 576  461 134   7.50 -    8.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 702  327 126   8.50 -    9.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 825  201 123   9.50 -   10.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 876   78  51  10.50 -   11.50 XXXXXXXXXXXXXXXXXXXXXXXXX
 903   27  27  11.50 -   12.50 XXXXXXXXXXXXX
```

Bristol Part II Distribution

```
VARIABLE NUM   2  LOWEST SCORE =   0.0  HIGHEST SCORE =  12.0  SCALE = X 2

RANGE =   13.0  MEAN =     6.2 STANDARD DEVIATION =    3.0 STAN ERROR =  0.10 NUM SUBJ =  903


   **PRINTING OF INTERVALS WITH ZERO FREQUENCY HAS BEEN SUPPRESSED**


 CUM FREQ FREQ      RANGE       ................................................................
  19  903  19  -0.50 -    0.50 XXXXXXXXX
  62  884  43   0.50 -    1.50 XXXXXXXXXXXXXXXXXXXXX
 137  841  75   1.50 -    2.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 199  766  62   2.50 -    3.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 277  704  78   3.50 -    4.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 365  626  88   4.50 -    5.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 461  538  96   5.50 -    6.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 572  442 111   6.50 -    7.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 682  331 110   7.50 -    8.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 771  221  89   8.50 -    9.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 847  132  76   9.50 -   10.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 881   56  34  10.50 -   11.50 XXXXXXXXXXXXXXXXX
 903   22  22  11.50 -   12.50 XXXXXXXXXXX
```

TABLE 4.6 (Cont.)

Bristol Part III Distribution

```
VARIABLE NUM   3  LOWEST SCORE =   0.0  HIGHEST SCORE =   7.0  SCALE = X 3

RANGE =     8.0  MEAN =     4.0 STANDARD DEVIATION =     1.8 STAN ERROR = 0.06 NUM SUBJ =  903

  **PRINTING OF INTERVALS WITH ZERO FREQUENCY HAS BEEN SUPPRESSED**

CUM FREQ FREQ      RANGE          ..................................................................
 41  903  41   -0.50 -    0.50 XXXXXXXXXXXXXX
103  862  62    0.50 -    1.50 XXXXXXXXXXXXXXXXXXXXX
187  800  84    1.50 -    2.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXX
332  716 145    2.50 -    3.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
496  571 164    3.50 -    4.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
685  407 189    4.50 -    5.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
846  218 161    5.50 -    6.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
903   57  57    6.50 -    7.50 XXXXXXXXXXXXXXXXXXX
```

Bristol Part IV Distribution

```
VARIABLE NUM   4  LOWEST SCORE =   0.0  HIGHEST SCORE =   6.0  SCALE = X 3

RANGE =     7.0  MEAN =     3.4 STANDARD DEVIATION =     1.7 STAN ERROR = 0.06 NUM SUBJ =  903

  **PRINTING OF INTERVALS WITH ZERO FREQUENCY HAS BEEN SUPPRESSED**

CUM FREQ FREQ      RANGE          ..................................................................
 54  903  54   -0.50 -    0.50 XXXXXXXXXXXXXXXXXX
139  849  85    0.50 -    1.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXX
269  764 130    1.50 -    2.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
449  634 180    2.50 -    3.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
638  454 189    3.50 -    4.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
812  265 174    4.50 -    5.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
903   91  91    5.50 -    6.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

Table 4.6 (Cont.)

Bristol Part V Distribution

```
VARIABLE NUM   5  LOWEST SCORE •   0.0  HIGHEST SCORE •   8.0  SCALE • X 2

RANGE •    9.0  MEAN •    4.8 STANDARD DEVIATION •    2.3 STAN ERROR • 0.08 NUM SUBJ •  903


   ••PRINTING OF INTERVALS WITH ZERO FREQUENCY HAS BEEN SUPPRESSED••


 CUM FREQ FREQ      RANGE        ...........................................................................................
  30  903   30  -0.50 -   0.50 XXXXXXXXXXXXXXX
  82  873   52   0.50 -   1.50 XXXXXXXXXXXXXXXXXXXXXXXXXX
 167  821   85   1.50 -   2.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 267  736  100   2.50 -   3.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 378  636  111   3.50 -   4.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 497  525  119   4.50 -   5.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 664  406  167   5.50 -   6.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 768  239  104   6.50 -   7.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 903  135  135   7.50 -   8.50 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```